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Journal of the Society of Arts.

FRIDAY, FEBRUARY 16, 1866.

Announcements by the Council.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

February 21.—"On Modern Legislation in regard to the Construction and Equipment of Steam Ships." By Thomas Gray, Esq., H.M.C.S.

February 28.—A Report by the Secretary on the results of the Art-Workmanship Competition, from its commencement, will be read, and a discussion taken upon it. The competitors and Art-workmen generally are invited to attend.

Cantor Lectures.

The next lecture of the course, on "Submarine Telegraphy," by Fleeming Jenkin, Esq., F.R.S., will be delivered as follows:—

Lecture IV. Monday, February 19.

Electrical Tests.

1. *Terms used.*—Electrical resistance, Ohm's law, resistance of battery, units of resistance, resistance coils, galvanometers, Thomson's galvanometers.

2. *Tests of Conductor.*—(*a.*) Meaning of "good conductor," object of having a good electrical conductor. (*b.*) Method of measuring resistance, Wheatstone's differential measurer. (*c.*) Specific resistance of pure metals in B.A. units; annealing. (*d.*) Effect of temperature; specific resistance of pure copper at various temperatures. (*e.*) Effect of impurities; quality supplied for various submarine cables. (*f.*) Specific resistance of German silver and some other alloys and their uses. (*g.*) Use of resistance test to determine temperatures. (*h.*) Continuity test.

3. *Tests of Insulator.*—(*a.*) Meaning of the words, "good insulator," object of having a good insulator. (*b.*) Test of leakage. (*c.*) Resistance to conductor across the insulator from the copper inside to the water outside, and method of determining the resistance. (*d.*) Effect of continued electrification. (*e.*) Effect of temperature on insulators. (*f.*) Resistance per knot of various insulators in cables actually manufactured. (*g.*) Specific resistance of various insulators at various temperatures in terms of B.A. units. (*h.*) Effect of pressure on insulation of gutta percha and india rubber. (*i.*) Effect of the absorption of water on the same materials.

4. *Tests at Sea.*—Object of tests. Thomson's marine galvanometer; effect of rolling of ships; of earth currents; system recommended.

The lectures commence each evening at Eight o'clock.

Institutions.

The following Institutions have been received into Union since the last announcement:—

Bollington, Useful Knowledge Society.
Congleton, Mechanics' Institute.
Droylesden, Educational Institution.
Pendleton, Mechanics' Institution.
Southport, Athenæum.

Artistic Copyright.

In compliance with the wishes of the gentlemen who addressed the Council on this subject, in the memorial already published in the *Journal* (p. 173), the Council have appointed a Committee to take the necessary steps for accomplishing the objects specified in the memorial, more especially as relates to Copyright in Engraving. The Committee will consist of the following gentlemen:—Mr. Wm. Hawes (Chairman of the Council), Sir Thomas Phillips, Messrs. D. Roberton Blaine, F. Hamel, S. Redgrave, Edward Smith, and E. M. Underdown,

Trade Marks Committee.

The Council have appointed a Committee, in accordance with the following resolution:—

Resolved—"That a Committee be appointed to inquire into the laws of England and foreign states upon the subject of Trade Marks, and to consider if any and what amendments are advisable and essential for the purpose of efficiently protecting the owners of trade marks against the piracy thereof; such Committee to communicate with any committees formed with a similar object in the United Kingdom and foreign countries."

The Committee consists of the following gentlemen:—

William Hawes, F.G.S., Chairman of Council.

Akroyd, Edward, M.P.
Allsopp, Henry (Burton-on-Trent).
Ashworth, Edmund.
Bartleet, R. S. (Redditch)
Bass, M. A., M.P. (Burton-on-Trent)
Bass, M. T., M.P. (Burton-on-Trent)
Batty, George.
Bazley, Thomas, M.P.
Bessemer, Henry.
Bird, William.
Blackwell, Thomas.
Blaine, D. Roberton.
Brook, Charles (Huddersfield).
Cammell, Chas. (Sheffield)
Campbell, C. Minton (Stoke-on-Trent).
Chambers, Thomas, M.P.
Chappell, Thomas.
Clark, J. (Paisley)
Coats, Thomas (Paisley).
Colman, J.
Copeland, Alderman.
Courtauld, Samuel.
Coxon, T. C.
Creed, Herries.
Dumergue, F.
Elkington, Alfred
Evans, Walter (Derby).
Figgins, Sheriff.
Finnis, Alderman.
Foster, H. R.
Gassiott, J. P., F.R.S.
Graham, Peter.
Hastings, G. W., LL.D.
Henry, Michael
Hunt, John.
Jackson, Robert (Sheffield).
Jackson, Wm. (Sheffield)
James, Edward, Q.C., M.P.
Johnson, J. M.
Kennard, R. W., M.P.
Lawrence, Alderman, M.P.
Lloyd, Sampson (Birmingham).
Mappin, Joseph.
Maudslay, Henry.
The Lord Mayor.
Palmer, George (Reading).
Reed, Charles.
Rimmel, Eugene
Rodgers, J. (Sheffield)
Roebuck, J. A., M.P.
Ryland, Arthur (Birmingham).
Rylands, Jno. (Manchester)
Salomons, Alderman, M.P.
Sandford, Sir Francis.
Silver, S. W.
Simmonds, P. L.
Smith, Edward.
Tapling, Thomas.
Tite, William, M.P.
Underdown, E. M.
Vickers, E. (Sheffield)
Waterlow, Alderman.
Webster, Thos., Q.C., F.R.S.
Welch, J. K.
Wilson, G. F., F.R.S.
Wright, J. S. (Birmingham)
Young, D. H.
Edmund Johnson, *Reporter.*
P. Le Neve Foster, *Secretary.*

With the addition of such Members of the Council as may desire to join it.

The first meeting of the Committee was held on Tuesday, the 13th inst.

Paris Universal Exhibition of 1867.

Forms of application for space, and copies of the regulations, may be had on application to the Secretary of the Society of Arts, and should be applied for without delay.

Although the 28th February, 1866, has been fixed as the last day for receiving demands for space, intending Exhibitors are requested not to delay forwarding such demands, but to send them as soon as possible.

Proceedings of the Society.

Musical Education Committee.

The following letter has been addressed to the Dean of each of the Cathedrals:—

Very Reverend Sir,—A Committee of noblemen and gentlemen, of which H.R.H. the Prince of Wales, the President of the Society of Arts, is chairman, has been sitting for some months for the purpose of collecting evidence on the subject of improving generally the musical education of the people of this country.

It has been pointed out to the Committee that free scholarships for study in the Royal Academy of Music, open for competition among youths showing a musical genius, who have been trained in cathedral choirs, &c., might have a useful influence on the choirs themselves, and be calculated to raise the standard of Church music generally.

I have been accordingly directed by the Committee to address you and the Chapter of your cathedral, with a request that you, or the precentor, or any other member of the Chapter interested in Church music, will have the kindness to inform the Committee whether the proposal meets with approval, and if you will oblige the Committee with any suggestions which may be calculated to increase the utility of the Royal Academy of Music to the country at large, and especially to music in churches, it will be esteemed an additional favour.

I have the honour to be,
Very Rev. Sir,
Your obedient, humble servant,
P. LE NEVE FOSTER,
Secretary.

Musical Education Committee.

The Committee met on Wednesday, January 10th, 1866. Present—Henry Cole, Esq., C.B., in the chair, Sir John E. Harington, Bart., Messrs. S. Redgrave, R. K. Bowley, and R. F. Puttick.

Mr. Michael Costa examined by the Committee:—

551. You have been many years in this country, Mr. Costa?—Thirty-five years, I think?

552. I believe you received your musical education at Naples?—Yes, at Naples.

553. That is about thirty-five years ago?—Yes.

554. Can you give the Committee any particulars about the working of the Naples Academy of Music?—The Academy at Naples was founded after that at Paris. Napoleon, when he came to power, instituted many academies, and one was an academy of music. At the time when Murat became King of Naples there were in existence three academies of music, viz., Pietà de Turchini, St. Onofrio, and Loreto, but he very wisely turned all three into one, and ordered it to be called Real Collegio di Musica (Royal Academy of Music), and established it on the same footing as that of Paris, with the difference that there were indoor pupils. The College had three governors, who formed the committee; they were nominated by the King. The Duke of Noja, president, the Chevalier Marinelli, and the Chevalier de Rogati.

555. The directors were not professionals?—No; noblemen appointed to conduct the affairs of the Royal College. Zingarelli was the director, also appointed by the King. He resided in the Academy, had the choice of the masters, and granted certificates to the pupils, on leaving the Academy, according to their merits, without which they could not get appointments. We had two masters for composition, two for thorough bass and organ three for singing, three for solfeggios (aided by the senior pupils, called "maestrini"), two for pianoforte, three for violin, one for viola (tenor), two for violoncello, two for double bass, and one for each wind instrument. We also had two Italian masters, one for arithmetic, one for mathematics, two for the Latin language, one for French, one for history, one for geography, one for declamation, one for dancing, and an actor who prepared the pupils for the stage, and, when operatic performances were given, he superintended the mise-en-scène, &c. We had a rector, a vice-rector, and nine prefects.

556. Were they teachers?—No: they had the charge of the moral discipline of the college, and to watch that the pupils attended to their duties. There was likewise a steward, who made all the contracts for the provisions necessary for the maintenance of the pupils, a secretary, and a keeper of all the instruments. The pupils were divided into four classes called *Camerate.* First class, *Camera de Piccoli,* 13 years of age; second class, *Camera de Mezzani,* 15 years of age; third class, *Camera de Semi-grandi,* 17 years of age; fourth class, *Camera de Grandi,* 19 years of age. The time was thus employed; the pupils got up in the morning at half-past six; at seven, prayers; at half-past seven, breakfast. On Mondays, Wednesdays, and Fridays, from eight to eleven, music masters; Tuesdays. Thursdays, and Saturdays, from eight to eleven, rehearsals with orchestra in the concert-room to try new compositions, by the pupils, and practice the works of great masters, also to read music at sight. Between eleven and twelve, recreation; at twelve, dinner; from two to four, master for literature, etc.; from four to six, recreation; from six to eight, on Mondays, Wednesdays and Fridays, general studies; the same hours on the Tuesdays, Thursdays, and Saturdays, the junior pupils took lessons from the seniors, who prepared them for the next lesson they were to take from the masters; at half-past eight, supper, and half-past nine, to bed. The senior pupils were allowed once a week to go the Theatre St. Carlos to witness and hear the operas performed there. The college had one hundred *piazze franche* (free places), and the same number paid for. When any vacancy occurred in the former, these were filled up by the most meritorious of the paying pupils. We also had female pupils, but they were entirely apart from the college; they only received instruction for the purpose of furnishing organists and teachers in the convents. One of the female pupils was the sister of the famous Lablache, an excellent organist and singer, and was appointed to a Convent in Sessa, near Naples, and subsequently, by her talent and exemplary conduct, became the abbess of it. Attached to the college were the *Scuole Esterne* for outdoor pupils; these were instructed by the *Maestrini* of the college, and, according to their merits, were afterwards received as indoor pupils.

557. Did the outside pupils pay for their education?—None paid. Every six months there was an examination and distribution of prizes. The pupils had six weeks vacation during the latter part of summer. During the year six concerts were given to which the public was admitted by special invitation of the committee.

558. Do you recollect about what was the annual expense of the Naples Academy at the time you are speaking of?—The king granted 36,000 ducats annually, a ducat being equal to five francs; but in that time a ducat

was nearly equal in value to a pound sterling; and when it incurred an extra expenditure to bring out operas, etc., the Government granted the extra money. King Ferdinand the First was very fond of music, and patronised it very much.

559. Did that constitute the total receipts, or were any funds received from other sources?—That was the only fund.

560. There is an academy in Naples still?—Yes.

561. Who succeeded Zingarelli at that academy?—Mercadante; but unfortunately he is blind. The Royal College is not now on the same footing. I know that many things do not go smoothly at present as they ought. Zingarelli, in his high position, was a very energetic and talented director; worked very hard for the interest of the college, and gave his entire personal superintendence to it. He used to go about the rooms when the pupils were taking their lessons, and if he had occasion to find fault with a master, quietly told him, "Please, Signor Maestro, before you leave the college I should be glad to see you."

562. Did he have the appointment of all the masters?—Yes; and also the power of their dismissal; but the latter never occurred in my time.

563. Was his selection subject to the final approval of the committee?—Yes; when a vacancy occurred, he recommended the person of his choice to the committee, who always relied on his judgment; the committee reported to the minister, and the latter to the king, for approval.

564. Can you tell the committee any distinguished pupils of that college besides yourself?—The college, in my time, produced many pupils of great merit. These were:—Manfroci, Mercadante, Conti, Fornasini, F. Marra, Rossi, Bellini, Ricci, Lillo, Lablache, and many others, besides several first-rate professors, but these having always remained in Italy, occupying the first post, are not known out of the Italian kingdom.

565. At the time you were at the academy it was in a flourishing state?—Perfectly so.

566. You have probably some information respecting other academies?—In the year 1834 I went to Paris, Milan, and Bologna. I was much pleased in every respect with the academy in Paris, then in the hands of the celebrated Cherubini. Not pleased much with that in Milan. The Bologna Liceo was the best after Naples.

567. Have you visited the Brussels conservatoire?—No; but after what I have heard and read in the report of Mr. Le Neve Foster, I think it to be equal to that of Milan. What are the results, however? Not very satisfactory. The post of Director in those establishments is only a "Place d'honneur," given to a man considered worthy of honorable retirement. The director receives every three months the report from the masters, and with their concurrence arranges matters as they think convenient. Besides, the director absents himself for a certain time, as well as the masters, and their several duties are performed in their absence by deputies. That system is not only bad, but injurious to the pupils; they take the style from their regular masters, but if these are continually changed the pupils will have no style at all. They give concerts, and mix pupils with professors. How can any one thus form an idea of the progress of the pupils? and the public is admitted by paying for the tickets. This system is entirely wrong. If the admission is by payment, the press has a right to criticise the performance, and criticism in that case does, in my opinion, more harm than good, and for this reason—if a pupil is praised he thinks he has arrived at the top of the tree; if severely judged, he is apt to be discouraged. At the college in Naples the orchestra was composed entirely of the pupils.

568. You think the pupils' concerts should be entirely private?—Yes.

569. What is your opinion with respect to the period of time that pupils should pass in the academy to complete their musical education?—At Naples the pupils were admitted between 12 and 13 years of age, and were generally kept there till 21. They were not permitted to leave the College under seven or eight years' residence.

570. You think an academy can prosper only when the education given is a substantive reality?—Certainly; but without the Government's support it will be useless to think of it. The masters must be well paid, and at a permanent salary. I believe the Royal Academy in London has no master for literature; that is certainly a very great drawback, particularly for composers and singers. I know, and am sorry to say, that some of the finest orchestra players can scarcely write their own names.

571. You are clearly of opinion that if the nation does not think it worth while to give anything towards music, the nation can hardly expect anything good in the way of music?—Just so. It would be a pity if the nation does not respond to the call, because we have the materials to establish the finest academy in the world. The young ladies have, in general, beautiful voices, and there is great talent for many departments, but who encourages them? Nobody.

572. Do you think it possible that sufficient interest could be elicited from the public to support an academy of music without any material support from the Government?—No; it would be a matter of charity not to be relied upon. I consider that music in this country should be placed upon the same footing, encouraged and supported, as it is abroad. On the Continent, music is considered a fine art, and one of the four sister arts—painting, sculpture, poetry, and music; but in England it is not so. Surely musical composition is fine art.

573. You think that England possesses plenty of musical ability, which is now allowed to go to waste?—It is admitted throughout all Europe that the Royal Italian Opera, Covent Garden, possesses the finest band.

574. Of what nation are the performers?—All Englishmen, except nine or ten.

575. Where have they been been educated?—Some at the Academy of Music here, and some received private tuition.

576. It would not be fair to infer that because we have an excellent opera band without such an Academy as we desire, therefore we can do entirely without an Academy of Music?—No; since the year 1837, when our gracious sovereign came to the throne, I had an opportunity of reforming the old opera band, and, with absolute power, I trained it according to my best knowledge and ability.

577. The fact is your band owes its excellence very much to your individual exertions?—To a great extent.

578. Therefore it affords proof of what adequate exertion can do with English materials?—Just so; and I feel confident that if the Government will afford the means to reorganize and place the Royal Academy of Music on a solid basis, it would produce composers, singers, and would supply good players for every theatre in the metropolis and the provinces, with fine orchestras as in France. Go where you like, from the largest to the smallest theatre, you will always find very good players throughout France; but they must be well educated.

579. The public would not have such an opera band unless they paid adequately for it?—Certainly not; if you require the services of a good professor, you must pay him well, not only for his talent, but to afford him also the means to use a good instrument. In Paris they have very good performers, but the instruments are worthless. I believe the violins do not cost more than twenty or twenty-five francs each; as for double basses, they are the worst instruments in the world.

580. I suppose twenty-five guineas would not be an extraordiuary price for a good violin?—No; in the Covent Garden orchestra all the instruments are good. I remember at the general rehearsal of "Faust," when M. Gounod heard the pianissimo, so rich and sonorous in the preludio to his opera, he was so enchanted that he said he never heard so rich and sweet a tone in any orchestra before, and that

it went through his heart. The same thing was repeatedly said by Meyerbeer, adding that there was no orchestra in the world that possessed such stringed instruments.

581. You have been good enough to look generally over the proposals laid before the committee by Mr. Cole?—Yes; and I like them very much. I would only make one suggestion. In the proposition No. 7, it is stated, "That the subscribers should pass bye laws for the government of the Academy; that they should elect a board of directors, and have the privilege of admission to the concerts." I do not think the subscribers should have the election of the president, vice-president, and committee.

582. You think they should be named by the Government?—Decidedly.

583. But as it is proposed that a portion of the income should be derived from other sources than the Government, would you not think it advisable that the subscribers should, to some extent, be represented in the councils of the institution?—I would not have them interfere with the internal government of the Academy.

584. You cannot give an opinion how far it would be politic in such an institution?—Let the subscribers have a right to hear the private concerts, and see the progress of the pupils, and have also the privilege of recommending new pupils to the committee.

585. Do you think it advisable to admit any professional element into the business management of the institution?—No; I agree with Mr. Cole in all his other proposals.

586. It has been suggested that it is more politic to attempt to reform the present Academy than to start an opposing institution. Do you agree with that idea?—Yes—certainly.

587. Have you heard that the Academy is under notice to quit its present premises?—No, I have not.

588. It is believed that they cannot stay in their present premises after Midsummer next.—I was not aware of that.

589. Would you recommend that the proceedings of the Academy should be entirely suspended while a new building was being provided for them?—I would not leave the pupils without instruction all that time.

590. You would make the best shift you could in the interim?—I would.

591. And you would prefer temporary accommodation rather than stop the Academy altogether?—Yes.

592. Have you any notion as to about what the cost of the academy would be properly managed?—I can form no idea.

593. You have seen the estimate given by Mr. Cole, viz., £12,000 per annum. Do you consider that sum would be likely to do the work properly?—If you have not in-door pupils.

594. Do you lay much stress on indoor pupils?—No; except to go through the duties more regularly. (Mr. Cole explained the system which is pursued with the art scholars in the school at South Kensington.)

595. Do you think £12,000 a-year would cover the expenses of such a system as that applied to music? I think so, to a limited number of pupils.

Mr. Cole—The pupils being rewarded, according to their excellence, as at South Kensington?

Mr. Costa—You admit a certain number gratis.

Mr. Cole—Yes; and having given proofs of their efficiency, they are paid according to their merits, some pupils receiving as much as 30s. per week for their lodgings and maintenance.

Mr. Costa—It might answer very well, I think; but the number of pupils under that system should be very limited.

Mr. Cole remarked that after ten years experience the system worked extremely well.

Mr. Costa—Of course you make no religious distinction among the pupils?

Mr. Cole—Certainly not. As the best illustration of that I may state that in one week we had an English Bishop, Cardinal Wiseman, and Dr. Adler, making inquiries as to the admission of pupils and aid from the department. As far as the department is concerned it would not have been known whether the pupils were of one creed or the other.

596. What period do you consider the musical training of the pupils should extend?—I should say, as a rule, from five to seven years would be necessary to attain proficiency. If a boy goes in at 13 and leaves at 21, I should say it would be sufficient to complete his education.

597. Mr. Macfarren, in his evidence at the last sitting of the Committee, suggested the desirability of having the Academy placed in connection with a church or chapel, if not of having one included in its own establishment, in which on Sundays full cathedral service should be performed by a choir comprising the whole of the Academy students. Also he thought it of vital importance to preserve the fundamental regulations of the Academy, which require that every student learn harmony, the pianoforte, and sight-singing; that every male student (except singers) learn an orchestral instrument, and, when qualified, take part in the orchestral practice. Do you concur in these suggestions?—I quite concur with Mr. Macfarren's idea of having a chapel attached to the Academy, with a good organ, and a choir formed by the pupils, and I am sure it would be highly beneficial to the students and would prove a great attraction; there you could gratify the subscribers who would support the Academy by admitting them to hear a fine performance of the real good English Church music, which is very abundant, and rarely heard well done. I do not concur with the second suggestion, "That every pupil should play the pianoforte and learn an orchestral instrument." I do not think it right to force a pupil to sing, or play the pianoforte, or other instrument for orchestra performance in the Academy, except that of his avocation, otherwise he will not be perfect in either of them. The Academy of Music must receive pupils who show talent for a certain branch of music, and cultivate the choice of their own inclination: then the result will be satisfactory. If, however, a pupil has inclination to learn more than one instrument let him do so, but never force him.

598. Would you allow pupils to go to sing in the public service of churches?—No; I would not allow the pupils to sing anywhere but in the Academy.

599. With regard to a theatre in connection with the Academy, do you think that advisable?—How can pupils be taught and prepared for the stage without a theatre? The theatre is most essential.

600. Complete with dresses and scenery?—Yes; everything.

601. You have expressed your opinion that music is not regarded in this country so much as a fine art as it ought to be?—Yes.

602. And that offers a serious drawback to music generally. Painting, sculpture, and poetry are differently treated to what musical art is. Do you not think that is a state of things to be deplored?—Undoubtedly so; but if the Government and the nation will take it up it would soon be all right.

603. You have had great experience of English singers—are you of opinion that it is necessary to establish a separate school for English singing, or do you think a general style of teaching, say that which is universally acknowledged to be the best style—the Italian style—is sufficient to train English singers in English singing?—The style must be good in any country, either in England, Italy, France, or Germany; the language only is different. With good masters you have good style, so as to establish a good school, which is required.

604. The opinion of Mr. Macfarren was, that the pupils should be trained by English masters, and they would pronounce English words correctly?—By giving the pupils good masters of elocution and declamation that object is fully attained. The pupils must have their musical education in thir own language first, which is the

English, and when they can sing and declaim well, then they should be allowed to sing in foreign languages.

605. Do you think it advisable to admit quite boys as pupils?—No.

606. Do you think the education of the boys should be left primarily to the cathedral choirs, and after that they might enter the Academy for further tuition?—First of all, no one can depend on a boy's voice; when it changes it very rarely proves to be a good one. Secondly, the style required in a cathedral is so peculiar that the undoing it is rarely obtained.

607. Do you think it necessary that there should be a musical library of works of reference?—There should be a first-rate library.

608. Are you aware that the government has accepted the gift of the library, as far as it goes, of the Musical Union?—I was not aware of it.

[Mr. Cole remarked that such was the fact, and that the same was deposited in the Department of Science and Art.]

609. With regard to the musical director of the academy, do you think that the whole of his time should be devoted to it?—Certainly, during the time of instruction and practice.

610. And that he should be responsible for its being properly carried out?—Yes; and he should guide the pupils at the rehearsals. When the pupils are able to compose they should conduct their own music, and the senior student should be the conductor of the academy band; thus you will have a conductor when he leaves the academy. It is impossible to make a colonel at once; he must have his apprenticeship. "Conductor" does not mean simply to beat the time, but he must enter into the feelings and intentions of the composer, and have judgment and tact to guide the whole body under his command.

611. You do not agree in the opinion that has been expressed, that the director of the academy should be a layman?—I do not. How can a layman direct, inspect, find faults, and correct what he does not understand? It would be almost the same thing to appoint a musician president of the Royal Academy and the National Gallery. The director of the Royal Academy of Music must be a most sound musician, an independent gentleman, and not influenced by prejudices or jealousies.

612. You think the principal of an academy should not teach himself, but only superintend the teaching?—Yes.

613. And that no part of his salary should be derived from teaching?—None at all. He should reside in the Academy, and have, as far as music is concerned, the entire control of it.

Cantor Lectures.

"On Submarine Telegraphy." By Fleeming Jenkin, Esq., C.E., F.R.S.

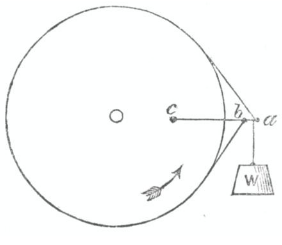
Lecture III.—Monday, February 12.

Laying and Repairing Cables.

The lecturer mentioned that he had received a letter from Messrs. Wells and Hall, stating that some lengths of their india-rubber cables had been at work for some time under water. This was not doubted, but did not affect the original statement, that much india-rubber had decayed, whereas no gutta-percha under water had decayed. Mr. Hooper had also misunderstood the statement in the abstract that pure india-rubber yielded to continued pressure; this was not meant to apply to Mr. Hooper's material, which is always more or less vulcanized. Attention was also drawn to a map of the telegraph lines between Europe and the East, prepared by Messrs. Bright and Clark, and kindly lent by them. The following is an abstract of the lecture arranged under the heads of the syllabus:—

1. *Stowage on board ship.*—The cable is coiled into large circular, or nearly circular, coils, so as to uncoil without receiving a twist, as shown on the last occasion. The coils are now held in iron water-tight tanks, and remain constantly under water. Tanks were first made for the Red Sea cable, but first used for the Malta-Alexandria cable. The tanks in the *Great Eastern* were three in number, from 51ft. 6in. to 58ft. 6in. diameter, and 20ft. 6in. deep. To prevent rolling, their centre of gravity should be only slightly below the water line. If the water be withdrawn from the tanks before the cable is paid out, the wires rust, and the chemical action heats them injuriously; with galvanized wires or cables covered with Bright and Clark's composition this heating does not occur. The eye of the coil round which the cable lies, generally from 6 to 8 feet in diameter, is filled with a cylinder, to prevent the bight of the cable from falling down, and possibly forming a kink or loop. Mr. Newall uses a cone permanently fixed in the centre of the coil. Messrs. Glass and Elliott lower their solid eye as the uncoiling proceeds. The cone appears to the lecturer to afford the best guarantee against kinking. It was used in the Persian Gulf expedition. When running out at high speeds the cable, if unchecked, would fly out, urged by centrifugal force, so as to be dangerous and unmanageable. This tendency is controlled by rings, lowered as the tanks are emptied, and first forcing the cable to run horizontally towards the centre and then controlling its upward motion. These rings were first used by Messrs. Newall and Co.

2. *Break.*—From the tanks the cable is laid in troughs to the break, by which a restraining force is applied to prevent too rapid egress. The troughs in the *Great Eastern*, from the fore-hold to the break, measured 450 feet. The cable is wound four or five times round a drum, 6 or 8 feet in diameter, and the rotation of this drum is controlled by friction. The turns round the drum hold the cable securely, and prevent its egress unless the drum itself turns. The riding of the cable is prevented by a simple contrivance, known as a knife or plough, which was exhibited on a model. On the *Great Eastern* this knife or plough could be adjusted. The simplest manner of applying retarding friction to the break is to hang a weight on to a break strap, the other end of which is fixed. If the weight is hung from that end of the strap which would be lifted by the friction of the drum as it revolves, the retarding force can never exceed the weight, and a limit may be thus placed to the strain on the cable. But it was found in practice that with a strap making less than one turn round the drum, a weight of, say four tons, had to be applied to give a friction of one ton; the limit due to the position of the weight was, in such a case, of small value, since any heating of the strap or dirt on its surface might rapidly increase the strain fourfold. Mr. Appold's break remedies this defect. The principle on which it is constructed is illustrated by the annexed diagram. The end of the strap a, on which the greatest strain comes, is attached to a lever, hinged at c. Between the centre of the drum and a, the other end is attached to the lever very near a; but between a and c the retarding friction is obviously equal to the difference of the strains on the end a and b of the break strap, and the weight w is almost exactly equal to that difference. This relation does not depend on the co-efficient of friction between the strap and the drum; if the friction increases, the weight w is raised a little, and the lever $a\ c$, owing to the eccentrical position of c, slightly lengthens the



break strap, reducing the friction. The opposite effect occurs if the co-efficient of friction diminishes. The motion of $c\ a$, required to tighten or loosen the break strap, is almost infinitely small, so that the angles of the break strap and lever and the relations of the strains do not sensibly vary. This arrangement was used on the *Great Eastern.* It worked admirably, and gives a perfect safeguard against the application of any unforeseen strain by the friction of the break strap. Strains may, however, occur from other causes, and for their detection a dynamometer is used between the break and the stern. The cable is passed under a weighted pulley, at a somewhat obtuse angle. The weight thus hanging on the cable is raised higher and higher as the strain on the cable increases. A scale is constructed by experiment showing the height corresponding to each strain. By this simple contrivance the actual strain on the cable can be observed at any moment. The following is a convenient formula for calculating the relation between the strains on break straps and the friction produced. Let Q be the strain on that end of the strap which holds back the wheel, P the strain on the other end, f co-efficient of friction, and b the angle embraced by the strap in circular measurement (unit = 57·296°).

Then; $Q = e^{fb} P$, where $e = 2{\cdot}71828$.
f may be taken for leather on iron .... = 0·35
" " iron on iron, wet ...... = 0·15
" " wood on iron, wet, less than 0·1

3. *Theory of Submersion.*—In October, 1857, Professor William Thomson published in the *Engineer* a short sketch of the true mathematical theory of the form assumed by a cable while sinking, and the strains to which it is subjected under various conditions. The consequences of this theory were much more elaborately worked out (independently of Professor Thomson's publication, the lecturer believes) by Messrs. Brook and Longridge, in a paper read before the Institution of Civil Engineers, in the spring of 1858. Much of what follows is taken from that paper. If the ship and cable are both at rest in still water, the latter hangs in a catenary curve, the strains on which are known and easily computed. This case actually occurs whenever a ship stops paying out cable, for instance, to cut out a fault; if the cable were suddenly stopped so as to lie at a great angle with the vertical line, a strain would be produced so great as infallibly to break the cable; thus for a catenary in which the cable at the point of suspension lies at an angle of 9° 30 with the horizon, the strain at the point of suspension is equal to 72½ times the weight of the cable hanging to the same depth vertically; so that in 2,000 fathoms the strain would be equal to the weight of 145 miles of cable; but the Atlantic cable would break as soon as the strain exceeded the weight of 11 miles. From this it will be seen that a cable cannot be immediately stopped whilst being payed out, but must be gradually checked while the ship is backed, so as to keep the cable where entering the water as nearly vertical as possible. Another conclusion which follows is, that the cable while being paid out cannot possibly be hanging in a catenary curve, since the Atlantic cable did lie at an angle of about 9°30′, and the strain, instead of being 2,030 cwt., was only about 12 cwt. The following consideration may help us to perceive how different the case of a body sinking regularly is from the case of a chain at rest. Suppose the ship to drop a number of spheres of the specific gravity of the cable into the water at regular intervals; each of these would, within about two feet of the surface, acquire a definite, sensibly constant velocity $v = \sqrt{\frac{w}{q}}$ where w = the weight, and q the resistance to the body moving at one foot per second; these spheres, moving with constant velocity at constant intervals of time, would lie in a straight line from the surface to the bottom, and would be more or less inclined to the horizon as the speed of the ship was less or greater. If the spheres were joined by an infinitely thin string, to which the water offered no resistance, they would form a cable which could be laid without any tension whatever, and with an amount of slack or waste depending simply on the inclination of the line to the horizon. The practical case of a submarine cable lies between these two extremes of the catenary and the isolated spheres; each short length of the cable lies like an inclined rod in the water, and has, therefore, a tendency to shoot back in a given direction, whereas the isolated spheres tend to fall vertically. Owing to this, cables, or, at least, heavy cables, cannot be laid without tension except at the expense of an enormous waste of cable. It will be unnecessary here to repeat the whole mathematical investigation which is given in Messrs. Brook and Longridge's paper. It will be sufficient to give the results arrived at. Mathematical readers will readily understand that these results are calculable from the data given:—

v = the velocity of the paying-out vessel in feet per second.
v_1 = the velocity of the cable paid out in feet per second.
w = the weight of one foot length of the cable in lbs.
ϕ = the angle which the cable at the surface makes with a horizontal line.
x = the height of any point A from the bottom of the sea.
q = the resistance in lbs. which the water opposes to the motion of each foot of the cable moving perpendicularly to itself, at the speed of one foot per second; q may be called the co-efficient of resistance to displacement.
q_1 = the resistance in lbs. which the water opposes to the motion of each foot of the cable drawn through it lengthways, at the speed of one foot per second; q_1 may be called the co-efficient of friction.
m = the resistance in lbs. which the water opposes to the motion of each foot of the cable moving perpendicularly to itself, at speed of v feet per second; m is assumed $= qv^2$.
m_1 = the resistance in lbs. which the water opposes to the motion of each foot of the cable drawn through it lengthwise at the speed v. m_1 is assumed $= q_1 v^2$.
t = tension in lbs. at point A, which in what follows will be assumed as at the surface where the maximum strain occurs.

Then if the cable be laid without any tension at the bottom, which is now invariably done, the equation to the curve assumed by the cable will become the equation to a straight line inclined at an angle to the horizon such that

$$(1.)\quad \text{Cos.}\ \phi = \frac{\sqrt{w^2 + 4m^2} - w}{2m}$$

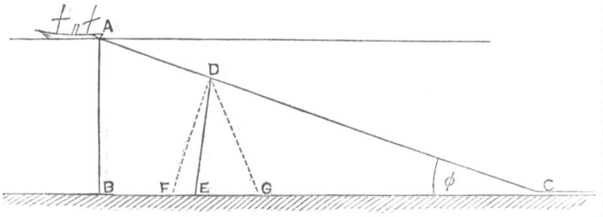
Or, what amounts to the same,

$$(2.)\quad \frac{\text{Cos.}\ \phi}{\text{Sin.}^2\ \phi} = \frac{qv^2}{w.}$$

From this it appears that the angle at which any given cable will be paid out is (when not tight at bottom), independent of the tension t (or of the velocity v_1), and is dependent simply on the velocity v of the ship. Cables which are bulky for their weight, or, in other words, are of light specific gravity, lie at a small angle, but by increasing the ship's speed any cable may be paid out at a small angle. We find further, when no slack is paid out,

$$(3.)\quad t = \left(w - m^1 \frac{(1 - \cos\phi)^2}{\text{Sin.}\ \phi}\right) x$$

$w\ x$ is simply the weight of a length of the cable hanging plumb from the ship to the bottom. This is the maximum tension that can be required to lay any cable without slack. This tension is always slightly diminished by a certain small portion of its amount constant, for a



given speed and cable. The annexed diagram may help to explain the results arrived at. The cable A C, lying on an inclined plane of water at the angle ϕ, is carried by a tension equal to the weight of a length A B of cable, somewhat as a chain would be in equilibrium lying on a frictionless inclined plane A C, and hanging down over a pulley at A to the depth B; but the inclined plane of water is not at rest; it yields under the cable at every instant at every spot; if the cable were pressed through the water in a direction perpendicular to itself, so that the plane of water yielded before the pressure of the cable, and did not slip along it at all, the above analogy would be perfect, and the tension at A would be simply equal to $w\,x$; but since we have supposed the cable to be laid without tension, and without slack at the bottom, any point D must finally come to a point E, such that E C = D C; and it will be easily seen that the point D to do this must move in a straight line E D. Now this line D E is not perpendicular to A C; it falls within that perpendicular D F, so that if we suppose the plane of water under A C to yield perpendicularly before it, we must also conceive the cable as slipping back a little on the plane by an amount corresponding to the space between D F and D E, but this slip is opposed by the friction of the water, which thus tends to prevent the cable from running back on the inclined plane, and so relieves the tension by a small amount. This amount is so small that it may be practically neglected, and would not have been mentioned did not the same considerations enable us to understand the effect of laying cable with a certain amount of slack. When this is done a point, D, moves in a line, say D G, differing much more in direction from D F than D E does. When much slack is laid, the cable slips back at a considerable velocity on the inclined plane, and meets with a frictional resistance tending considerably to relieve the tension. Thus, when the cable is paid out at a velocity v_1, we have

$$(4.)\quad t = \left[w - m^1 \frac{\left(\frac{v^1}{v} \cos.\ \phi\right)^2}{\sin.\ \phi} \right] x$$

When v_1 is considerably in excess of v, the fraction of the whole tension which the friction m^1 subtracts from $w\,x$ is very considerable. It also increases rapidly as the speed of the ship increases, and it further increases if the specific gravity of the cable be small, for then it lies at great length in the water, presenting an immense surface to be gripped by the water. The friction on each foot is but small, but when twelve or thirteen miles of cable lie in the water, presenting a surface of 70,000 or 80,000 square feet, the result is practically very important. Assuming a mean speed of 10·4 feet per second as that at which the Atlantic cable was paid out when lying at an angle of 9° 30′ in 2,000 fathoms of water, with a tension of 12 cwt., we obtain the following values for the constants:—

$$\left.\begin{array}{l} q = 0{\cdot}085 = 0{\cdot}81\ D \\ q_1 = 0{\cdot}0085 = 0{\cdot}081\ D \end{array}\right\} \text{ where D = diameter of cable in feet.}$$

From some observations it would seem as if the angle had been even less than the above, in which case q would be larger and q_1 smaller. From Beaufoy's experiments we should have expected q to be more nearly 0·65 D; but the roughness of the cable may account for the difference, as it certainly does for the great difference in the co-efficient of friction, which is nearly eight times that which a smooth surface would present. It is probable that for a smooth iron cable the value of q_1 would be more nearly equal to 0·001 D, and $q = 0{\cdot}065$ D. One reason will now be plain for giving in the foregoing tables the strength of the various cables relatively to the depth in which they are to be laid. The strain required to lay them is always a fraction of that depth, but the strain will not be always the same fraction of the depth, but will be smaller for the lighter cables when laid slack.

4. *Application of Theory.*—The practical results of equation (4) are most important. To lay any cable, however light, quite taut, we require nearly the tension due to a weight of the cable hanging plumb from the surface to the bottom; but by increasing the bulk of any cable, though we do not diminish its actual weight, we may, by laying a little slack, diminish the tension very greatly. With such a cable as the second Atlantic the tension was thus diminished more than half; to lay it taut would have required nearly 28 cwt., and 12 cwt. was the amount actually required when about 15 per cent. slack was paid out. The strain could be maintained constant in all depths, by allowing a little more slack to run out in deep water, and even this could be prevented by a slight increase in the speed of the ship. No relief at all comparable to the above, is obtained by paying out heavy cables slack; but on the other hand, still lighter cables can be paid out under still more favourable conditions. The ratan and hemp cable (No. 11, Appendix 1) would, with 12 per cent. slack, be paid out without any strain at all, and if more slack than this were desired the cable would have to be pushed out of the ship. Nearly the same might be said of a bare gutta-percha wire. The Atlantic cable, in the last expedition, was laid in depths varying from 1,750 to 2,000 fathoms, at speeds for the ship varying from 4¾ to 6¾ knots per hour, while the cable ran out at from 5 to nearly 8 knots per hour. The angle, according to one method of observation, varied from 9° to nearly 12°, but was somewhat less according to other observations; 9° 30′ seems to have been a usual angle. The slack paid out in deep water ranged from 9 per cent. to about 18½ per cent. On the last day the slack was about 14·8 per cent. The strain on the cable was very constant, ranging from 10 cwt. to 14 cwt., and generally being between 11 cwt. and 13 cwt.; the pitching of the ship never caused more than about 2 cwt. difference in the strain; but once, when going slow to change holds, the strain was 17 cwt.; this accords with theory. The lecturer has to thank the engineers of the Telegraph Construction and Maintenance Company for the above information.

5. *Proposed Improvements.*—Reels have been proposed in ships as a substitute for the coils in tanks. Their great mass in motion would be difficult to control. Mr. Siemens actually tried with some success a reel for a light cable and drove it with an engine; he abandoned the plan for the old system; the defects which the reel is supposed to remedy

do not exist; Captain Selwyn has proposed to use a reel floating in the sea, ingeniously retarded by paddles, which would prevent too much slack from being laid; it hardly becomes a landsman to tell a sailor that such a reel would be unmanageable; but the difficulties of coiling in water, of launching the reel if coiled on land, of protecting the surface of the cable against collisions, of testing the cable, of remedying any defect, should any arise, and even of preventing one coil from cutting into those immediately below it seem unavoidable, and the defects the invention is supposed to remedy are imaginary. Buoys have been proposed to relieve the cable from part of its weight; any hollow buoys would be crushed very shortly after leaving the surface. Mere wooden floats would do little, and be difficult of attachment. This invention also labours under the disadvantage of being unnecessary, since cables can be paid out with 12 cwt. strain or less, which will bear 150 cwt. Vanes on a cable, opposing its slipping backwards, would be correct in principle, although probably quite impracticable; the result aimed at is obtained by increasing and roughening the surface of the cable. Most engineers who have had practical experience deprecate any attempt to catch the cable by nippers after it has left the ship. The danger of fouling is more considerable than the extra chance of safety given by the nipper. Lastly, many proposals have been made for some kind of elastic arrangement, to compensate for the change of strain caused by the rise and fall of the ship. When cables are paid out so nearly horizontally as is now the case, these arrangements, even if practicable, are not required, the alteration of the strain, caused by the motion of the ship, is quite inconsiderable, and there is great difficulty in devising any elastic arrangement which by the inertia or momentum of its parts would not aggravate the evil, such as it is. Unless when going very slow, in very bad weather, the best conceivable elastic arrangement would be useless if not injurious.

6. *Repairs in shallow water.*—So long as the outer wires of a cable remain sound, repairs in shallow water are always easily effected. The cable is caught by a grapnel, lifted to the surface, cut, tested, and if the fault be near at hand, one end of the cable is buoyed, the other end passed round a drum driven by a steam engine, which gradually hauls in the cable till the fault is found, when it is repaired, the cable again paid out, and spliced at the part buoyed. Bad weather and a rocky bottom are the chief difficulties to be contended with. Sometimes the cable is not cut or hauled on board, but simply underrun, passing over a grapnel or sheave hung outside the bows of the ship; as the ship moves forward the cable rises in front and is again lowered behind the ship. There are many points of practical interest connected with repairs in shallow water, and the lecturer refers those who require further details to Mr. F. C. Webb's paper in the *Transactions of the Institution of Civil Engineers*, 1857-58. If the bottom be good, *i. e.*, sandy or muddy, cables can always be recovered within 100 fathoms, and they are frequently hauled up in much greater depths.

7. *Repairs in deep seas.*—The only method hitherto practised with success has been to commence in shallow water and gradually haul the cable on board as described above. By carefully keeping the cable hanging vertically from the bows the strain on it will not greatly exceed in calm weather the weight of the cable hanging plumb from the ship. Cables have been recovered in this way out of depths of 1,000 and 1,500 fathoms at the rate of about a mile per hour. Messrs. Newall were very successful in the Mediterranean in recovering many cables by this plan, and the lecturer has seen a cable hang for three days at the bows of a ship where the depth was 800 fathoms, while the ship pitched violently owing to bad weather; the cable did not break, and was relaid with success. Even in this case the rise and fall of the ship did not injure the cable, but the change in the strain on the cable was great, and any good elastic compensation would have been useful; the cable itself, yielding say ¼ per cent. in a mile, gives a certain elasticity. Although this method of recovering deep sea cables is not hopeless, the risks are great; bad weather or a weak point in the cable entail almost certain failure. A good nipper to catch the cable, should it break in board, as it frequestly does, might be of material service. Few persons will be sanguine enough to expect that a cable could be steadily picked up for 1,000 consecutive hours, or say forty days, with about half its theoretical breaking strain necessarily always upon it. We should, therefore, be grateful to the engineers in charge of the late Atlantic expedition for showing us that even in 2,000 fathoms of water the attempt to hook a cable with a grapnel is far from hopeless. The chance of success by this method will now be examined. If a cable were laid absolutely taut along the bottom of the sea, when hooked by the grapnel it would rise a little way in virtue of its elasticity; if it stretched one per cent., by the time ten miles of it were off the ground the apex would be half a mile from the ground; a result few are prepared to expect, but the strain on the cable where caught would be very great, equal to the weight of about 24 miles of the cable, though the weight on the grapnel rope would be only that of ten miles of cable. The result, therefore, of trying to raise a cable such as the Atlantic laid taut, would certainly be to break it; but cables are not laid taut in deep water, and the Atlantic is laid with a mean slack of about 12 per cent., and in the last days we may even count on 14 or 15 per cent. slack, that is to say, for every 100 miles passed over, 114 or 115 miles of cable were laid. Lay on the floor 114 inches of chain, between two points 100 inches apart, lift it in the middle on a hook, the two ends will hang down in catenary curves, and when the cable at the extremities is just off the floor, the hook will be 23·3 inches from the floor. Quite similarly a cable laid with 14 per cent. slack will, when caught by the grapnell, hang in two half catenary curves, and by the time 11·4 miles of the cable are off the ground, the grapnel will be 2,330 fathoms from the bottom, *i.e.*, at the surface of the Atlantic. The strain on the grapnel rope will be the weight of the cable lifted, or about 11·4 miles; the strain on the cable itself at the point of suspension will be much less, being only about 3½ times the weight of the cable hanging vertically, or say 8 miles of cable. (Observe that the strain on the cable and the weight of the cable are not synonymous. When the two ends hang plumb, the strain on the cable at top is half the weight of the cable carried. When there is little slack, the strain is much greater than the weight carried.) If the depth were only 2,000 fathoms, the strain on the cable when brought to the surface would only be equal to the weight of about 7 miles of cable. Moreover, the actual cable is not held at any point except by its own weight, and there will be a pull at the bottom tending to haul in slack towards the grapnel amounting to several tons: but even without counting upon slack obtained in this way, it is clear that if the cable will bear 11 miles of its own weight, it could, under favourable circumstances, be hauled to the surface by a single grapnel.

Tables VII. and VIII. give the proportions and strains on catenaries in various convenient practical forms. Thus, from Table VII. we see that if ten per cent. slack be laid, the maximum tension on the catenary lifted in, say one mile, will be the weight of 4·52 miles of cable. In two miles depth the strain would be the weight of 9·4 miles of cable. In the latter case, 2 × 5·67 = 11·34 miles of cable will be off the ground, and the grapnel rope must be strong enough to bear this. Table VIII. gives similar information, supposing we do not start from a definite per-centage of slack, but know the proportion of the dip made by a rope to the strain. But although from these tables it appears that the Atlantic cable might be lifted by sheer pulling, this course is not advisable owing to the extra strains produced by the heave of the ship, the resistance

TABLE VII.

Giving length of cable lifted with a given slack, and hanging in a catenary curve, &c.

Slack in per-centage.	Tension at highest point in terms of the weight of a length of cable hanging vertically from the surface to the bottom.	Length of curve in terms of versine.	Length of versine of span 100.
0	infinite	infinite	0
1	47·6	19·42	5·2
2	20·8	12·75	8·0
3	13·5	10·20	10·1
4	10·0	8·74	11·9
5	8·18	7·84	13·4
6	6·90	7·16	14·8
7	6·01	6·64	16·1
8	5·39	6·24	17·3
9	4·88	5·92	18·4
10	4·52	5·67	19·4
11	4·18	5·43	20·45
12	3·89	5·21	21·5
14	3·49	4·89	23·3
16	3·12	4·58	25·3
18	2·89	4·37	27·0
20	2·67	4·17	28·8
22	2·48	3·98	30·6
24	2·39	3·89	31·9

TABLE VIII.

Showing the length of a catenary curve of constant span = 100, with various deflections at the centre, and giving strains at highest point in terms of the unit length of chain.

Proportion of versine to span.	Length of versine or dip.	Length of curve.	Strain at highest point in terms of the unit length of chain.
0	0·00	100·0	infinite
$\frac{1}{12}$	8·33	102·1	160·9
$\frac{1}{11}$	9·09	102·6	149·3
$\frac{1}{10}$	10·00	103·0	137·6
$\frac{1}{9}$	11·11	103·4	125·8
$\frac{1}{8}$	12·50	104·3	115·2
$\frac{1}{7}$	14·29	105·4	104·3
$\frac{1}{6 \cdot 5}$	15·38	106·4	99·7
$\frac{1}{6}$	16·67	107·3	94·5
$\frac{1}{5 \cdot 5}$	18·18	108·9	90·5
$\frac{1}{5}$	20·00	110·4	86·2
$\frac{1}{4 \cdot 5}$	22·22	112·4	82·1
$\frac{1}{4}$	25·00	115·4	79·1
$\frac{1}{3}$	33·33	125·4	75·6
$\frac{1}{2}$	50·00	177·3	103·5

to displacement by the water, the friction of the water, possible currents of water, the possible drift of the ship to one side of the cable, and the possible existence of a weak point in the cable. Owing to all these elements the practical chances of success by sheer pulling are very small. It has been proposed to lift the cable by a number of ships, acting like so many piers to a suspension-bridge. It is difficult to suppose that they would keep their respective positions accurately, or all haul in at the proper rate. It has also been proposed to catch the cable at one point, then at another nearer the end, then to drop the first grapnel, and catch the cable again nearer the end, and so, working hand over hand, reach a point at last so near the end that the cable could be lifted nearly vertically. This is better than the last plan, but is unnecessarily complicated, and the cable might easily be injured in the attempts to catch it at so many points. The simple plan which at once occurred to all practical men, is to catch the cable with one ship by a holding grapnel, and then to cut it with a grapnel from a second ship, some three miles to seaward; the loose end held by the first ship could then be hauled on board with little strain. This plan will probably be adopted, with much chance of success. It is certain the cable *was* caught, and probably it can be hooked again; if so, there should be no difficulty in raising it, unless it is rusted to a much greater extent than we have any reason to expect. The grapnel of the first ship should be a holding grapnel, of which several models were shown, otherwise the loose end might fly back over it if the second ship cut too near the first. The second ship should have a cutting grapnel, of which models were also shown, lest if the attempt were made to break the cable by brute force it might break at an inconvenient point. Mr. Latimer Clark's grapnel, which would answer either of these purposes, was exhibited. The cable when hooked releases a catch, allowing a block, to which the grapnel rope is attached, to be hauled up the shank, pulling round two right and left hand screws by two steel bands; the screws close the jaws, which grip the cable or cut it; or one grapnel may be made both to cut and grip the cable. The grapnel can lie in only two positions, and if dragged in the proper direction, cutters placed at two diagonally opposed corners would cut the cable certainly to seaward, and the jaws hold the landward end. A simple form of holding grapnel, conceived by Mr. Carpmael, jun., was shown; in this the cable is jammed between the prongs and a kind of half bollard. A holdfast or cutting grapnel, designed by the lecturer, was also shown. Each prong is hinged on a pin projecting beyond the shank, and the prong is so shaped at the root that the cable when on it closes the prong tighter and tighter on itself, whereas the end of the prong when dragging through sand or mud is opened like a Trotman's anchor.

Eleventh Ordinary Meeting.

Wednesday, February 14th, 1866; J. W, Bazalgette, Esq., in the chair.

The following candidates were proposed for election as members of the Society:—

Brock, James, 21, George-street, Portman-square, W.
Fretwell, John, 24, Mark-lane, E.C., and 8, Upper Homerton, N.E.
Howard, Raymond, 29, King-square, Goswell-street, E.C.
Patry, James, 7, Cambridge-terrace, Regent's-park, N.W.
Rutson, John, Newby Wiske, Thirsk, Yorkshire.
Salt, Titus, Jun., Saltaire, near Leeds.
Shoolbred, Frederick, 51*a*, Portland-place, W.
Turner, Cornelius, St. James's-road, Old Kent-road, S.E.
Wickham, William, 33, Tavistock-street, Covent-garden, W.C.

The following candidates were balloted for, and duly elected members of the Society:—

Ashworth, George Leach, Roche Mount, Rochdale.
Barry, John Boyle, 16, St. Peter's-terrace, Notting-hill, W.
Blackburn, George, 32, Fore-street, City, E.C.
Brooks, William Elliot, 14, Gt. Queen-street, Lincoln's-inn-fields, W.C.
Butler, William, St. Helen's, Lancashire.
Ella, John, 18, Hanover-square, W.
Fase, Berkeley W., 22, Oxford-street, W.
Gushlow, George, 60, Newman-street, Oxford-street, W.
Homfray, H. R., The Place, Stradishall, near Newmarket.
Jonas, John, 150, Leadenhall-street, E.C.
King, John, The Rushetts, Thames Ditton, S.W.
Macintosh, John, Craven-street Chambers, Strand, W.C.

Myers, Abraham, 171, New Bond-street, W.
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Phillips, Charles Palmore, 109, Fenchurch-street, E.C.
Pullar, Wm. Black, Perth.
Ross, J. C., Ravenglass, Cumberland.
Sim, William Fisher, Rose Bank, Peckham Rye, S.E.
Storr, John S., 26, King-street, Covent-garden, W.C.
Terry, Charles, Newport Pagnell.
Trevelyan, George, M.P., 8, Grosvenor-crescent, S.W.
Vansittart, Miss, Reading.
Walker, William, 1, Stock Orchard-villas, Holloway, N.
Wall, Prosper, 6, Fortess-terrace, Kentish-town, N.W.
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The Paper read was—

ON THE GAS SUPPLY OF PARIS.

By George R. Burnell, Esq., C.E., F.G.S.

Amongst the wonderful adaptations of physical science to the daily usages of life, there is hardly one which is calculated to excite greater attention than the application of carburetted hydrogen gas to the purposes of illumination. It is essentially a discovery of modern times; for there must be many here present who can recollect the "darkness visible" that enshrouded London streets in the days when oil lamps were in vogue; but we get so soon accustomed to the enjoyment of luxuries, that very often the first steps that attend their acquisition are forgotten, and we take them as matters of course. Somewhat of this kind of reasoning has been adopted with respect to the use of gas; and the public are inclined to expect that the manufacturers of this article, which has now become almost a necessity of life, should give them the benefit of their experience, without taking into account the cost they must have incurred in acquiring it. The discussions that took place on the occasion of granting the new concession for lighting the city of Paris, and the movement that is at present going on in our own metropolis, seem to have been marked with this spirit; and though the Paris Gas Company has succeeded in obtaining what may be considered as favourable terms in return for the supply of gas, yet the inhabitants of London evidently are disposed to expect that the companies should supply them at such prices as would hardly leave them a fair profit. It therefore struck me that a statement of the conditions under which the Gas Company of Paris have contracted to supply the town with that article of consumption might be of interest, if only to enable the engineer to compare the systems adopted in the two countries with respect to public works; the more especially as it would appear that considerable misapprehension exists with respect to the rights and privileges of our neighbours in this particular matter. It is proposed also, in the course of this paper, to notice the points wherein the manufacture and distribution of gas in Paris differ from those which are followed in London.

The formation of the one gigantic monopoly that has the privilege of lighting Paris took place in this manner. There had been several companies, that were formed for the supply of the city, which had, from the period of their first establishment, enjoyed a species of districting arrangement, as we should call it, and they agreed to merge their separate capitals in the six companies that had treated with the municipality in the month of December, 1846. In the year 1852, when the empire was first established, the Government thought it to be its interest to encourage the formation of great companies who should possess the means of employing large numbers of workmen, and give rise to the profitable investment of capital. The hygienic effect of the establishments for the manufacture of gas in the interior of the city also weighed with the Government; and they were desirous that at least three or four of these should be removed from their original positions in the centre of the town. Under these circumstances it was suggested to the shareholders of the six companies that their union would be received with pleasure; and then that their application for the prolongation of their concession, which expired at the close of 1863, might be entertained upon conditions that were to be the subject of future deliberation. The consequence of this proceeding on the part of the Government may be described, in substance, to have been that the concession for lighting Paris was granted to the united companies on these terms. The three establishments in the interior of Paris, at the Avenue Trudaine, the Rue du Faubourg Poissonière, and the Rue de la Tour du Temple, were to be suppressed, and their manufacture was in future to be conducted in the new gas station that was to be erected at La Villette. The canalization of the interior of Paris (understanding by that term the lines of mains and distributing pipes) were to be altered, and made so as to correspond with the probable future demand upon them; the company agreed to pay the town the sum of £8,000 for the privilege of laying their pipes in the public ways; also it agreed to pay the town two centimes a mètre cube, or about 5½d. per 1,000 cubic feet, as a compensation for the *octroi* dues; it moreover agreed to share the profits of the working above 10 per cent. with the municipality of the city of Paris after the expiration of the first sixteen years.

The material and plant that were employed, and all the land and buildings devoted to the manufacture, were to remain the property of the company at the expiration of the lease, which was fixed at 50 years from the 1st of January, 1856, and the company bound itself, in the meantime, to alter the position of their mains, &c., whenever the town might require to execute works for the water supply, sewerage, &c.; so far, indeed, has the lease foreseen the probability of future operations of this nature, that it provides for the company's removing their pipes into any subways that the town may construct, without thereby giving rise to any claim for compensation. For these terms the company agrees to supply gas for the public lighting at the following prices:—There are three sets of flames, that are respecpectively $2\frac{1}{4}$ inches wide by $1\frac{1}{8}$ inches high, which is paid per hour, 0·015f.; $2\frac{5}{8}$ inches wide by $1\frac{1}{4}$ inches high, which is paid per hour, 0·021f.; and $3\frac{5}{16}$ inches wide by $1\frac{3}{16}$ inches high, which is paid per hour, 0·030f. When the gas is sold to the town by metre, it is paid for at the rate of 0·15f. the metre cube, or about 3s. 4½d. per 1,000 cubic feet; the company is obliged to fix, paint, and repair the lamp posts and candelabra, but the town furnishes them. For private consumption, the company was entitled to charge for the gas supplied at the rate of 0·30f. per metre cube, or about 6s. 8¾d. the 1,000 cubic feet, upon agreement of three months' date, terminable at the option of either party; but the parties so receiving the gas cannot employ it without the production of the certificate of the person employed by the town to examine (and who exercises the right of approving) the fittings and other apparatus. The company is at liberty to modify the terms of payment, in this sense, that it is allowed to receive the payment in monthly sums, but this must be on the condition of its being paid in advance. No subscription whatever can be refused by the company, provided the demand be drawn up in accordance with the model that is approved by the municipality. The company is at liberty also to charge at so much per hour, or by the metre. A model of each set or series of metres is deposited at the town hall, and every metre must correspond with the details of these; they are bound to be verified as often as the administration may require. All expenses attending these metres are at the cost of the consumer, whether in the first place or in the subsequent maintenance of them; practically, they all come from the stores of the gas company. It is to be observed that the gas company is not bound to deliver gas to the private consumer at other periods than those in which the mains would be under charge for town lighting. It was moreover stipulated that if during the period of fifty years, for which this lease was granted, there should be discovered any new system of lighting, the gas company should be bound to introduce it, under conditions that were to be fixed by the municipality; or the municipality reserved to itself the right of granting a fresh concession for the new system of lighting, without being bound to compensate the company in any way whatever. There are in the lease various provisions as to the amount of coal, &c., that the company is obliged to hold in stock, and as to the payment of the mains, valves, cocks, syphons, &c., that are placed in the public ways; these are estimated, in block, to be worth the sum of two million of francs, or £80,000, which sum would have to be paid to the company, in case of the town taking the concession into their own hands, or at the expiration of the concession. The quality of the gas is provided to be such, that a lamp of the first series mentioned, which would consume 100 litres per hour, should give a light equal to 0·77 of a carcel lamp burning 42 grammes of rape oil in the hour; for the lights of the second category, burning 140 litres an hour, the light is to be equal to 1·10 of that above given; and for the lights consuming 200 litres in the hour, it is provided that they shall yield 1·72 of the light of a carcel lamp as described. It may be stated that this standard corresponds very nearly with the English one, of what we should call seven sperm candle gas.

To enable any one to appreciate the position that the company occupies under this contract, it is necessary to observe that the coal used in Paris is mostly of Belgian and north of France origin; a small portion of cannel, or boghead, is only introduced when the illuminating power of the gas is below the standard. The average yield of this coal is about, per hectolitre (according to the figures that were published by the company in the course of the discussion that took place before the treaty was signed), gas, 22·94 metres; large coke, 31·11 kilogrammes; breeze, 12·07 kilogrammes; tar, 4·50 kilogrammes; and ammoniacal liquor of the value of 0.036 francs. The quantity of ammonia compounds that are present in the coal is considerable, and the company is obliged to exercise great precaution in ensuring the purification of the gas, in order to comply with the clause in their treaty which provides that the means they adopt for that purpose should be the best that are known. Yet with all these drawbacks upon the commercial results of the operation, the Paris Gas Company has always paid a good dividend, and the last distribution of profits was at the rate of 19 per cent.; whilst the average rate appears to have been of about 16 per cent.; a result that would cause great heart-burnings with the municipal reformers and the political economists of our own country, who will not allow any company to divide more than 10 per cent. The capital that is invested in the works consists of share capital 4,000,000 francs, and of bonds of the company about £3,200,000 sterling; or, in all, about £4,000,000, for a total population of 1,600,000 persons, which would make the rate at which the gas service of Paris is performed about £2 10s. per head of the inhabitants. This calculation, however, is somewhat in excess of the facts of the case, as the gas company has lately undertaken to supply some of the external villages of the Department of the Seine, such as Romainville, Puteaux, Charville, St. Denis, Maisons Alfort, &c., which form the subject of a separate treaty; but the above calculation may be taken as representing the proportionate price that is incurred in this service. It may be added that the price that is agreed to be paid by the communes beyond Paris for the lighting is, for the public lamps, 20 centimes per metre cube, or about 4s. 3½d. per 1,000 ft. c.; for the private lighting, 40 centimes per metre cube, or 8s. 7d. per 1,000; upon a descending scale that may reach, finally, 6s. 8¾d. per 1,000, in proportion to the consumption. The high price that is agreed to be paid for this service may be explained by the length of main that is unproductive to the company in these cases; but it certainly seems to be exorbitant, when the freedom of the gas from *octroi* dues and other municipal taxes is taken into account. The company is bound to conduct, in every instance, the gas to the front entrance of the subscriber, and the latter is entitled to employ whomsoever he thinks fit to execute the distribution of the gas in his interior; and, provided the subscriber presents the certificate of the prefect or his delegate, that the works are well and properly executed, the gas company is bound to supply the subscribers with gas. The expense of branching upon the main and leading to the meter, is, of course, borne by the subscriber; the meters, as was said before, are bound to be of approved patterns, and verified as often as may be required by the police; they are furnished by the company, but are at the charge of the housekeeper, as far as regards their first cost and repairs, if those are undertaken at his request.

It may be remarked that the system of regarding the supply of the gas consumed in Paris as a municipal service, has entailed upon the private consumers the necessity of paying a higher price for the gas they consume than they would naturally do if the service were left to be regulated by the ordinary rules of trade. The municipality, in the exercise of its rights over the surface of the roadway in fact, has only consented to grant the monopoly of the gas supply to the company, on the condition of their supplying the public lamps at reduced rates, and of sharing in the profits of the concern after it has been established such a time as is sufficient to relieve it from any chance of failure. It is true that, in this manner, the town authorities will be enabled to devote a portion of the profits arising from the sale of gas to the relief of the other taxation of the town; but this is only an indirect way of making the consumers of gas pay for the water, paving, or other municipal services; and it is objectionable, as the control of those services can never be efficiently performed so long as the total expenses of them are not distinctly brought under discussion. The worst of this system is, that the price of gas can hardly ever be reduced, as the municipality is directly interested in the maintenance of the rate of profit. The precautions then taken to ensure the delivery and the quality of the gas are, therefore, quite illusory, and they seem to be intended rather to lull the suspicions of the consumer than to exercise any real influence upon the operations of the company, for so long as the quality of the gas is equal to the average quality that is distributed in the French towns, there is no probability that much fault would be found with it, let it be ever so bad.

At present there may be found a great amount of the ammonia compounds in the gas, and it is rather deficient in the illuminating power when compared with the London gas, but this may be owing to the quality of the coal that is used. The effect of the participation of the town in the profits of the company must, however, be such as to superinduce a carelessness on the part of the *employés* who are charged with the verification of the quality of the gas, and of the means adapted for ascertaining the quantities supplied. There is now apparently a great deal of anxiety displayed by the town authorities about the illuminating power and the purity of the gas, for they have organised a complete system of control and superintendence of both the public and private lighting, that appears, at first sight, to be most efficient. There are twenty-one persons who are constantly employed in testing the gas, and who are paid at salaries varying from £200 a-year to £48, the total sum voted for the salaries of these people for the next year being about £1,060; there are also 130 inspectors of the public lighting, at salaries varying from £200 a-year to £48, who figure in the town budget for a total sum of £10,480: and 32 inspectors of private lighting, who are charged with the verification of the metres; these are paid salaries varying from £240 to £40 a-year, and they figure in the budget for £2,600. The superintendence of this service is, theoretically, very well arranged; it remains to be seen whether it will really operate for the protection of the inhabitants, when the town has a direct interest in the successful results of the company, which it will have when the period of sixteen years, during which the company has the enjoyment of all it can make, shall have expired. All these questions, of the power of a municipality to interfere with a private company, however, form part of the greater question of the organisation of the relations between the public body and the private citizens, that admits a question of widely-different solution, but it would be somewhat out of place to discuss them here, as they would be better treated in a separate paper. The object of the present one is to endeavour to trace the system adopted by our French neighbours in the supply of gas to their capital; and, therefore, after having stated the conditions that the company and the municipality have agreed upon, it is proposed to state the manner in which the former of these parties has endeavoured to fulfil its part of the contract.

There are in the neighbourhood of Paris, and within the lines of the fortifications, ten gas stations, of different capacities, but all subordinate to the great station of La Villette. These stations are—1. La Villette; 2. Les Ternes; 3. Passy; 4. Vaugirard; 5. Ivry; 6. Charronne; 7. Belleville; and the three that are situated in the surrounding communes of St. Denis, Boulogne, and Charenton. As was said, the station of La Villette is the most important of these; it suffices for the manufacture of one-third of the gas that is consumed in Paris; the stations of Passy and Vaugirard supply together almost another third; and the other stations contribute about equally to the total consumption. The centre of the consumption is about the Church of St. Eustache, and the positions of the stations have been so chosen that they are mostly situated upon a circle, whose radius would be about that of the distance of the station of La Villette from that point. The station of La Villette is situated on the extreme verge of the town, being only separated from the fortifications by the military road; but the other works are often situated in the densely-peopled parts of Paris, to the great dissatisfaction of the *Conseils de Salubrité*, who complain very much of the smells given off in the process of manufacture. As, however, all the operations connected with the conversion of the residual products of gas making are carried on at La Villette, there seems to be little reason for finding fault with the company on this score; but the tendency of the sanitary reformers to hunt up, as it were, the factories that have been moved once in accordance with their suggestions, is not the less worthy of remark. The preference for La Villette, as the principal station for the manufacture of gas, may, however, be easily explained: it is situated in the quarter that is entirely manufacturing, and is in the immediate vicinity of other similar establishments; it is immediately upon the canal that brings to Paris the produce of the northern coal-fields of France; it is traversed by the Northern, the Eastern, and the Central Railways; and though it is somewhat high as compared with the level of the lower part of the town, it is only a little above the average level of Paris. The coal stores, which, by the way, are bound, by the treaty with the town, to be large enough to hold two months' stores, the retort houses, the coke stores, and the purifying houses, are situated on the north of the Chemin de Ceinture; the gas-holders are situated on the south-eastern side of that line; and the establishment for the conversion of the waste products is situated towards the north-west of the retort house, being separated from the latter by the Chemin d'Aubervilliers. The total area of the establishment is from 120 to 130 English acres.

On this plot of ground the retort houses are erected, and are provided with, each, a set of condensing pipes immediately adjoining the retorts, and a set of coke towers, or scrubbers, and the purifiers, that are within a series of buildings parallel to the retort houses, but separated from them by a paved court. The retorts are set in beds of eight each, back to back; the group of eight having seven retorts in each that are double, so that the total number of retorts at work at present is about 1076; but the quantity of gas that the company makes is considerably increased by the product of the ovens, from which it obtains smothered coke, for the use of iron and brass founders, railways, &c. The style of retort used is a clay retort, of the usual D shape, that is about 8 feet 2½ inches long, by 2 feet 4 inches wide, and 1 foot high in the clear; and it is to be observed that the French engineers prefer the use of the closed retort over the fire-clay ovens to that open at both ends (as in some of the London companies' works), for they contend that it is impossible to maintain an equal temperature in the ascending mains that must be used in the latter case, so that the gas escapes up one of these to the detriment of the illuminating power, or to the destruction of the dip pipe, according to the temperature. The gas in the Paris works passes from the retorts into an hydraulic main, and thence through a set of condensing pipes, that are placed outside the building, in sets of three rows of ten pipes each, to the set of double retorts. An exhauster here takes the gas, and thus relieves the retorts of the back pressure; this exhauster is set in motion by a steam engine of 16 horse power. There is a second machine, for the purpose of relieving the pressure upon the coke ovens, and this gives rise to special arrangements for condensation, purification, &c., to be noticed hereafter, and quite distinct from the ordinary service of the gas factory. The exhauster takes the gas from the condensers, which are made particularly large, so as to effect the greatest possible amount of condensation (which the French engineers attach great importance to, as a means of ensuring the purification of the gas), and passes it to the scrubbers and the purifiers. In the scrubbers, or the coke towers, the gas is subjected to a system of washing, for the purpose of extracting as much as possible the ammoniacal liquor, the tar, and the sulphur compounds, that it may still retain; and then passes, without any intermediate process of washing, to the purifiers, where it is exposed to the effects of a mixture of sulphuret of iron, lime, slacked and in powder, and sawdust, in the proportions of 1 metre cube (about 1⅓ yard cube) of sawdust to 0·10 metre cube of lime in powder, with about 2 cwt. of sulphuret of iron. This mixture is found to be preferable for the purification, as it is capable of being renewed several times, and is especially used in France, because there the agricultural interest does not appreciate the employment of the lime refuse of the purifiers. The gas here is passed through four successive layers, or rather series of layers, of the description above given, and is then passed through the station meter to the gas-holder where it is stored for distribution.

There appear to be differences of opinion amongst the Paris engineers with respect to the conditions of the distillation of their coal, and with respect to the methods to be adopted to prevent the formation of the sulphide of carbon in the gas. The present practice of the gas company is, however, that of effecting the distillation with great rapidity and at great heat, and combating the tendency of the gas to the formation of the sulphide of carbon, by means of a most energetic condensation. The charges that are generally employed are four-hour charges, at high initial temperatures, of about half a ton to each retort; the French engineers obtain from this quantity of coal the average yield of 9,300 to 9,500 cubic feet of gas (which is more than the London companies on the average do from the superior coal of Newcastle), and about 13 cwt. of good merchantable coke per ton. The proportion of condensing surface that is found necessary under the French system of replacing the washing by an energetic condensation, is about 20 feet superficial to every 1,000 feet cube of gas made; and the surface of purifying medium that is used is about 4 feet for the same quantity; formerly the washing was performed by an additional process before the gas passed through the purifier, and it consisted in the gas being forced to bubble through a solution of ammoniacal liquor after it had passed through the coke towers, but now this process is dispensed with, so far as regards the passage of the gas through the ammoniacal liquor. The gas passes through the station meter, and from thence it passes into the gasholders preparatory to the distribution; these are eight in number, at the station of La Villette; they are 107 feet in diameter, and 46 feet rise in a single lift, and are supported by a scaffold in the centre when down. The distribution of the gas from these reservoirs takes place under the pressure of rather more than 1⅛ of an inch during the day time, and in the night time of 3⅜ to 3¾ of an inch. It may be that this pressure may be required to overcome the difference of level of the factory, which is somewhat above the points of delivery in Paris; or it may be accounted for by the small dimensions of the distributing means. The efforts of the company are, however, directed to the remedying this cause of loss, which must always, to a certain extent, act to prevent the due proportion between the mains of distribution and the quantity of gas they would discharge in a given period of time being observed, owing to the interest the company have to continue their working through the pipes that they are bound to yield to the town at the expiration of their lease. By the peculiar arrangements adopted, the Paris Gas Company has reduced the loss that ensues from the excessive pressure that accompanies the distribution of the gas to a minimum. We shall have occasion to revert to this subject; but it may be as well to state that the loss of the gas registered by the station meters, both in private consumption and in public lighting, was, in the year 1864, only 10 per cent.—a most insignificant proportion, if the quantity that is lost by the condensation in the mains, the amount that is not carried to account by the private consumers, and the thousand causes of loss that the gas must be exposed to, are taken into account. The average loss of the London gas companies is at least from 15 to 25 per cent. of the quantity they register at the stations.

There are at La Villette numerous contrivances for the preparation of merchantable coke that are well worthy of attention, but which it is not worth while to describe at present, inasmuch as the care with which this branch of the manufacture is conducted is essentially a local necessity, called for by the habits of the Parisians. The same thing may be said with regard to the conversion of the tar, ammoniacal liquor, and other waste products, all of which the Paris Company is obliged to convert to useful purposes themselves, but which we in England find can be more economically converted by the means that our manufacturing chemists make use of. There is, no doubt, immense skill displayed in this detail of the Paris fabrication, but it may be passed over, together with the brick, tile, and retort factory that forms an important part of the establishment at La Villette, and which manufactures for all the other stations in Paris. In Paris, the gas company had, in fact, to organize every detail of the service, and to create the industries that are connected with the disposal of the coke and the refuse, and that were necessary for the making of the gas; they, therefore, were deprived of the advantages that the English companies possess in the greater division of labour that prevails in their country and which permits them to concentrate all their attention upon the strict object for which they are established. The coke ovens mentioned above may be cited as a proof of this; they are calculated to convert about six tons at a time, that yield about 8,000 or 8,500 cubic feet of gas to the ton, and 13 cwt. of smothered coke; but both the gas and the coke that are thus obtained are of inferior qualities of their respective kinds; both tend to lower the lighting and heating power of the gas and coke they yield. The brick and fire-clay manufacture of the Paris Gas Company, however, yields products of a superior kind; but it is to be suspected that it does so without much reference to trade profit; and the same may be said of the engine factory, where the company manufactures for sale the Lenoir's engine, so extensively used in building operations in Paris. It is found that, with all the disadvantages that the Paris Gas Company has to encounter in the disposal of their waste products, they manage to derive from their operations upon the coal they consume about the proportions of 1,000 for the gas, 200 for the coke, 20 for the tar, and 2 for the other residual products. The tar, it may be added, is never burnt under the retorts; it is too valuable, and meets with too ready a sale, to allow of any such application; the ammoniacal liquor is principally used for the preparation of sulphate of ammonia, that meets with the readiest sale in England.

It is calculated that the total yield of the La Villette station is about equal to five millions of cubic feet per day when the works are in full operation; and the distribution of this quantity takes place in the busiest and most bustling part of the town. The other works do not present anything very particular, excepting perhaps the station at Vaugirard, which is specially reserved as an experimental station, and where the company have been at work for the last three years upon Mr. Siemens' system of economising the heat that is employed to produce the distillation of the coal; hitherto without success, it must be observed. The Paris Gas Company, by their monopoly of the supply, are enabled thus to "try all things" that are proposed in the matter of lighting with the best means and appliances that can be disposed of.

The distribution of gas takes place through mains that are of as large diameter as $3\frac{5}{16}$ths feet, exactly one mètre, they are all of wrought-iron, upon Chameroy's patent, and in that respect the Paris supply differs from that of London, which, in consequence of Mr. Michael Angelo Taylor's Act, is compelled to receive its gas supply through cast-iron mains. The Chameroy pipes are put together in lengths of 15 or 16 feet; the joints are rivetted and brazed; the whole is then coated with a preserving coat of bitumen, and the joints are made with a male screw on one end, and a thickening out, formed on a mandril, to receive a female screw on the other, which is then packed with gasket and white lead. The opinions of English engineers are unfavourable to this style of pipe, but the experience of the Gas Company of Paris for the last twenty-seven years seems to be decisive as to its merits in all cases where the soil is of an alkaline nature, and is not charged with water. I was informed by M. Camus, the sub-engineer of the works, who is also an Engineer of the Ponts-et-Chaussées, that he had ascertained the wear and tear of 1,000 metres of wrought and cast-iron mains of the same diameter, respectively, in the course of the year 1861, and he found that they presented the following results. He found that the cast-iron showed that the proportion of the leakage, that was owing to accidental breakage in the pipes, was 1·000, whilst that quantity was, for the wrought-iron, 0·460; the proportion of loss through the use of the pipes by time or depreciation was, for cast.iron, 0·353, for wrought-iron, 0·198; the proportion of loss by shaking of joint was, for the cast iron pipes, 1·77, for the wrought-iron, 0·520. There may be greater care and attention paid in Paris to the repairs and maintenance of the pipes, but the results of the experiments tried in this case seem to indicate that the cause of the diminished loss upon the registered quantity of gas must be sought for in the use of these mains; and at the present day, when so much attention is forcedly turned to the question of the leakage of gas pipes, on account of the construction of subways by the Metropolitan Board of Works, the subject acquires additional interest. The house distribution also takes place in Paris through lead service pipe, that must be another cause of diminished leakage; but the private consumer is at liberty to employ whatever system he may think proper after the passage of the gas through the metre. From the report of the gas company, to their shareholders last year, it appears that the total consumption of gas in Paris was about 3,567 millions of cubic feet, for a population that was estimated at 1,650,000; and the company had, in their prevision of an increased demand, increased their manufacturing powers to 4,141 millions. The length of pipes that were employed in the lighting of Paris was 546,861 metres; that of the annexed zone, of 424,985 metres; that of the banlieue and the surrounding district, 165,346. The number of public lights supplied by the company for the account of the municipality was 26,849; the number of private consumers was 59,554, in the year 1863, the last for which I have been able to procure the returns. It may be added that the lamps that are used for the lighting of the Boulevards are placed at distances of 25 metres apart on the same line; in the Rue de Rivoli they are about 14 feet apart; in the court-yard of the Louvre they are about 20 feet apart; the burners being, in the majority of cases, at 10 feet above the pavement. The lighting of Paris is, in fact, most brilliantly and lavishly executed, in the best quarters of the town at least; it leaves, however, much to be desired in the poorer portions, which are about as badly lighted as the analagous parts of London.

I have mentioned the desire that the public seem to have at present for the laying of the pipes in the subways that have been constructed by the Metropolitan Board of Works, and have hinted at the provisions that have been introduced into the treaty that prevails between the City of Paris and the gas company, with the object of facilitating the placing of the pipes in that manner. The treaty contains, indeed, a clause to the effect "that the town reserves to itself the right to displace, and even to remove altogether, at the expense of the concessionaires, and without any indemnity, the pipes every time that it may think the public interest may require it. If it should suit the municipal administration, during the continuance of this lease, to relieve the public ways of the excavations necessary for the laying of the gas pipes, and to dispose the sewers so as to receive them, the concessionaires shall be bound to remove their pipes to the positions prepared for them, at their own expense, upon all the points where the city shall have executed the works for this purpose." Yet with this precaution and this right, the city of Paris does not think of calling upon the gas company to remove their pipes; nay, the water pipes are in Paris carried into the sewers, which are there rather subways than simply sewers, and the engineers of the city most energetically oppose the introduction of the gas pipes into them. Experience has shown that there are fatal causes at work to produce the explosion of the escaped gas in these cases, which all the care of the engineers cannot guard against. There have been three accidents, as M. Belgrand informed me, in the gallery of the Rue des Martyrs; there have been two accidents in the court-yard of the Louvre; and the accident that took place last year, the consequences of which I myself saw, on the bridge of Austerlitz, was a fatal commentary upon the danger of the system of laying the gas pipes in subways. In this case the pipes were carried over the haunches of the bridge in a gallery that had an entrance at either end, that served as a means of ventilation, and it had a means of escape in the middle; the gas was shut off at both ends, and the quantity there was in the pipes allowed to burn off; yet an explosive mixture was formed, and it was set on fire, probably by a workman throwing down a match. Fortunately this occurred in the early morning, and the few people there were passing the bridge were attracted to the side where they could witness the passage of a steamer that happened to be passing; there were consequently no passers-by injured, but two workmen were killed, and several others were carried off to the hospital; the whole length of the pavement of the bridge was blown up for the length of 180 or 200 metres, and about 12,000 francs worth of damage done to the bridge. M. Belgrand was, in fact, quite borne out in his opinion, that "in no city where there was anything like a regard for human life, would the notion of carrying the gas-pipes in a covered way be for an instant tolerated." He had, it must be observed, more than eleven years' experience in the Paris subways, and yet, with all the advantage of the most careful superintendence by the engineers of the Ponts-et-Chaussées, and the effect of the French law of compensation for accidents, to enforce the observance of the necessary precautions, he did not scruple to come over here to London to give evidence against the scheme of the Metropolitan Board, that is again brought before the public with so much persistency. The fact is, that without a regular system of ventilation, that would entail an enormous outlay, there cannot be any safety in the system of subways as applied to gas pipes; and the Metropolitan Board do not seem to have contemplated the execution of even the smallest precaution for this purpose.

The Paris Gas Company is managed, as all the important operations of that country of a similar nature are, upon the strictest principles of discipline, order, and superintendence. The administration is composed of a certain number of directors, who are chosen from the body of the shareholders, generally speaking from amongst the original proprietors in the various gas companies that were amalgamated together, and they are assisted in the management by M. Gayffier, ingenieur-en-chef des Ponts-et-Chaussées, and M. Camus, ingenieur-ordinaire of that body, who have under their orders a numerous staff of engineers, chemists, practical men, and clerks, that would frighten any English board of management. Thus the expenses of the salaries to the various people employed in the factory, in the maintenance and laying of the mains, and in the office of the company, was not less than about £88,000 in the course of the year 1863; but at this charge the service is performed with a degree of perfection that we in England have no conception of. The cost of every detail of the manufactory is known to the last centime; the waste that attends the operations of the London companies is unknown; the accounts are kept in the most elaborate manner, and the gas company provide for their own servants with a liberality that we in England have no conception of. The result of the system is, that in Paris the gas works are managed at about 58 per cent. of the total receipts; which may be accounted for by the fact of the great success of the speculation that the directors manage, and by their having no inducement to introduce any great economy in their working, in consequence of the participation of the town in the profits of their concern after a certain time. There is, indeed, every inducement for the directors to indulge in expense in the management; none to induce them to save; and as the city of Paris has also a direct interest in knowing the cost of every detail of the fabrication of gas, it is questionable whether at any time the *frais d'administration*, or the office expenses, will be much decreased. This is certain, that the Paris Gas Company is managed with consumate skill; and though we in England would do very unwisely, as I think, to adopt the system that prevails in the neighbouring capital with regard to the supply of gas—because it is founded upon principles of political economy which are, I think, wrong, and it would involve an interference with our private habits, which I think would be intolerable—yet there are many things that seem to be well deserving our study, and our imitation, in the manner the Paris Gas Company carries out its contract. The system at Paris is, in fact, designed for the atmosphere of France; it would fail if introduced here, where "every man does what he likes in his own eyes."

DISCUSSION.

Mr. George Godwin, F.R.S., said they must be much obliged to Mr. Burnell for his admirable paper. Some important facts had been brought before them in a very interesting manner, but he was not able himself to agree with that gentleman in what appeared to be his leading object in the paper, viz., to make us more satisfied with what was done for us in England. It was not likely that Englishmen would put up with such a preposterous arrangement as was made for the inhabitants of Paris. The notion of tying themselves down for 50 years to take their gas at 6s. 8½d. per 1,000 feet (with allowances and deductions), notwithstanding any inventions and arrangements for cheapening it, seemed perfectly ridiculous. It was true if any new mode of lighting was introduced, the municipality could call upon the gas company to put it into practice, or could do so themselves without making compensation. After all, however, the people of Paris at that moment paid very little more for their light than in London. He was assured, on the best evidence, that the light there was much superior—in other words, that a certain number of cubic feet of gas in Paris gave more light than the gas of many of the London companies, who, even at the present day, supplied an article that was very far from satisfactory. It was true the municipality of Paris partook of an advantage to the extent of 5½d per 1,000 feet and divided the profits beyond 10 per cent. after sixteen years; so that they had an interest in keeping up this price. It was not likely that we should permit such an arrangement; although we were, perhaps, not much better off with our arrangement than the Paris people. It occurred to him some years ago to initiate a movement against the high price charged by the gas companies in England, and against their management. It went on for a long time, and was taken up by others, but it brought him nothing but personal abuse, and even such an instance as a man holding a large number of gas shares, at whose house he was visiting, putting a pistol to his head and saying if it were not for the consequences he would blow his brains out, because the course Mr. Godwin had been taking was likely to ruin him and his family. A few years after that very person derived 25 per cent. more from his shares than he did when that movement began. The gas companies took the usual course of opposing improvements and keeping up the price, but they were forced into a movement which damaged some of the old companies, and this would be the case again if they persisted in their opposition to the gas pipes being laid in the subways formed for them. He regarded it as idle to say that the escape of gas could not be guarded against. They were told that the escape from the mains was still very great, as was manifest from the state of the soil round the joint of an old gas pipe; the loss to the companies was great; the damage to health would be great, by-and-bye; and in order that they might go on laying down pipes with bad joints and other careless arrangements, they brought forward the evidence of one solitary French engineer to prove that explosions were a necessary consequence of pipes being laid in subways. In the case of Nottingham the system had been carried out without damage, and he was satisfied that this plan was a perfectly practicable one, and it would be a disgrace to the companies if they persisted in opposing its adoption. In many buildings he had seen as much as half a mile of pipes of iron and of softer metal running through the different rooms, but there was no escape of gas because the joints were properly made. He was satisfied if the gas mains were laid in the subways, and a proper system of ventilation provided, no better plan could be adopted. At present the public were subject to the perpetual annoyance of disturbances of the streets, and he could state that within three years Long-acre had been closed for traffic on five occasions during the laying of gas and water pipes and the construction of sewers. All that nuisance might be avoided by using the subways, and notwithstanding Mr. Burnell's eloquent endeavours they must persist in pressing this matter on the attention of the gas companies, and if they would not afford the public redress, it was to be hoped that the legislature would do so.

Mr. Thomas Hawkesley entirely disagreed with the gentleman who had just addressed the meeting. He (Mr. Hawkesley) had had thirty-five years' practical experience of this subject, having been the engineer of the Nottingham Gas Works, to which Mr. Godwin had alluded. He would tell them the real facts of the case. The subway at Nottingham was a little pitiful channel, of about 200 yards in length, and the gas-pipe which was laid on it was four inches in diameter, the street having very few houses, and, consequently, there were very few branches from that pipe. It so happened, also, that this little channel had a rise in the short length he had stated of very nearly 40 feet, and consequently it ensured for itself a tolerably good ventilation. He need hardly say that these were circumstances which did not apply at all to such a place as the metropolis. It was remarkable how great were the apprehensions of the workmen of the gas company in reference to this subway, for they would not go into it unless the gas was shut off, and even then they used a safety-lamp. They were told that gas had been laid in subways, and that gas had been lighted in them without danger, but the danger was occasioned by the insidious escape of gas by leakage, and when this occurred in any confined space, an explosive compound was formed, which was liable to produce a most serious disaster, particularly in a subway, where the whole street might be bodily raised up, and the passers-by would run the risk of being injured, if not killed. A good deal had been said about the escape of gas in the streets, but he would assert that it did not reach to anything like 5 per cent.; in general it was much less. What was called leakage was simply the loss which a gas company sustained upon the gas, as ascertained, in the first place by the meter at the stations, and in the second by the money which the gas company received. A thousand and one things happened between the station meter and the receipt of the money by the company. In the first place there was leakage at the works, which was very considerable. In the next place there was the consumption of gas upon the premises, which was to be counted by millions of feet a year, and which very few gas companies took into account. Then the gas went into the mains, from which there was a very slight escape indeed, and that escape passed into the soil, where it was absorbed without danger. A great loss occurred from the service-pipes, much more than from the mains of the company. That was a loss which ought as far as possible to be prevented, and if gas companies generally used lead pipe instead of wrought-iron for services, as was done in many places with great success, they would not suffer in this way. The gas eventually went to the meter, which professed to measure the whole that passed through it, but it often did not, and any defect of the meter, whether wet or dry, was against the gas company. Then there was all the surreptitious and fraudulent consumption of gas, which in a great city was not inconsiderable. Then, further, there was the waste in the public lamps, which was greater than any other, for this reason: each lamp was a consumer with only one light, and the pipe must be as full of gas for that consumer as for a private consumer using ten or twenty lights, and thus there would be a greater proportion of leakage. All these things put together went by the general name of leakage, whilst the escape from the mains of a well-managed company was not more than 2½ per cent. Mr. Hawkesley instanced the case of a gas company in Denmark whose works he superintended, and in which the whole leakage, over a period of three years, did not average 5 per cent., and at Nottingham, before the introduction of Lord Redesdale's Meter Act, the leakage was as low as 8 per cent., but owing to the operation of that Act it had latterly been as much as 14 per cent.

The way in which accidents would happen in subways was this:—A gas company alone could not control all the operations of the subway; other workmen would be employed there who might be the occasion of accidents. If the streets of London were generally subwayed, he had no hesitation in saying that with 2,000 miles of subway, there would not be a day without an explosion, if the gas mains were laid in them; and it would be impossible, in the nature of things, to prevent this. If they had gas-pipes in the subways, they must have workmen there, and they would also have the London thieves there, to the great peril of the jewellers' shops which were contiguous to the subways. Passing now to what had been said with regard to the gaslights in Paris, he would say he did not find anything better there than we had at home. The quality of the gas, the mode of manufacture, the amount of production, and the system of distribution, were in every respect inferior to what we had here, and, above all, the price of gas was fifty per cent. higher than our maximum price. The French system of political economy was the worst that could possibly be adopted. It was a system by which the municipality was bribed to participate in the profits on high prices, and the consequence was that those who consumed gas were made to pay a portion of the taxes of those who did not do so. The same thing had been attempted with various degrees of success, and want of success, in this country, a notable example of which existed—and to a certain extent still exists—at Manchester, but under modified circumstances. For many years the corporation of Manchester charged a very much higher price for their gas than the companies in the surrounding towns, and the money so obtained was applied to municipal purposes. The consequence was a certain portion of the community were taxed for the benefit of the other portion. For a time that system went on very well, but it ultimately gave rise to a violent class agitation, which it was always desirable to avoid; one portion of the community was arrayed against the other on the price of gas, and that went on for several years, and at last resulted in the gas consumers beating the non-consumers, and then the price of gas was brought down to something lito a reasonable amount. To go into a comparison of the systems in France and England would occupy too much time. All he would say on that point was—Paris was a much better lighted city than London, but the Paris gas in illuminating power was inferior to ours. The fact was, in Paris the people lived, not as we did, one alongside the other, but one above another, and the consequence was the population there was distributed over a much shorter length of streets. In Paris they had one lamp to every 60 persons; the consequence was, that in the principal streets the lights were brought very close to each other; but it did not thence follow that because the city was better lighted, the gas was better. Its inferiority was accounted for by the description of coals they used; they, nevertheless, made as good gas as they could under the circumstances, and they took good care to use the kind of burner which gave the most perfect combustion. This was a matter which was neglected in London, but we were improving in that respect; and when we paid as much attention to these details as was done in Paris, the London gas would give a greater amount of light than that in Paris.

Dr. **Wylde** remarked that in the present advanced state of science there might be no practical difficulty in the employment of the subways of cities as channels for the laying of gas and water mains, so as to prevent the constant annoyance arising from breaking up the streets for those purposes. He argued that equally in subways as in large ramifications of pipes in hotels, &c., the exercise of the olfactory nerves would always sufficiently indicate an escape of gas to a dangerous extent; and in the case of the mains of a gas company, the great thing to be attended to was the proper jointing of the pipes, by which the escape of gas into the subways would be effectually prevented.

Mr. **Gore**, having had some experience in the laying of gas mains in this country and abroad, was inclined to think that the promoters of the subway system were at the present moment somewhat in the dark on that question. He could quite understand that in situations where there was a sufficient current of air to carry off the escaped gas there could be no explosion, but it did not follow that in a subway the current of air would be so rapid as to have this effect. Having been engaged, in 1861, in laying down gas mains in Valparaiso, the geological formation in some parts was such that at six inches below the surface of the soil granite was reached, and through that material a channel had to be chipped away of sufficient depth to admit of the gas main being laid down. Theoretically that would be supposed to form a very beautiful channel in which to lay the pipes, but a reference to the books of the company would show that the cost of repairs in that channel alone amounted to seventy-five per cent. more than in double the length at other parts of the town where the pipes were laid in a different material. Mr. Hawkesley had very properly said that the soil was the best safeguard against the escape of gas, and at the same time it formed the best elastic cushion on which to lay pipes. In laying pipes in a subway, there must be a number of rigid fixed points or brackets on which they must rest, and there would be a severe vibration occasioned by the traffic passing overhead; the effect of which on cast-iron mains so supported would, in a very short period, be very serious, in causing leakage at the joints. He (Mr. Gore) was now engaged in preparations for lighting with gas the city of Mexico, and he had visited every establishment at which he thought he could gain information. Amongst others he had met gentlemen connected with the subways in Paris, and on his mentioning the subject to them, they strongly advised him not to carry the mains through subways.

Mr. W. **Macfarlane** was not satisfied, upon the evidence adduced by Mr. Burnell, as to the undesirability of the employment of subways for the laying of gas mains, nor did the observations of the last speaker satisfy him more on the same point. He thought if they were not prepared to alter the material of the pipes they must alter the construction of the joints, for if they put pipes in a subway with the present system of jointing, there would be a liability to great escapes of gas. There was, however, no reason why an improvement should not be made in this respect. The question was whether iron was the proper material for the pipes, unless the interior were coated with a preservative substance; and if, besides this, a better system of joints were introduced, he had no doubt that subways might be used for gas-pipes without danger.

Mr. **Burnell**, in reply upon the discussion, would simply refer to the observation of Mr. Godwin that the practical objection to the use of subways for gas mains rested on the sole testimony of one French engineer, M. Belgrand. Upon that he would remark that he had referred especially to that gentleman because he was the principal engineer in that department in Paris, and had had the largest practical experience in the laying of gas pipes in subways. He might mention that M. Belgrand's evidence on that point was confirmed by the opinions of M. Dupuit, who formerly occupied the position of M. Belgrand, by those of MM. Mouton and Huet, engineers of the Ponts-et-Chaussées, and also by M. Leloup, inspecteur des eaux, as well as MM. Gayffier and Camus. The only evidence in Paris anything like favourable to the subways was that of the architect of the Louvre. Therefore, on the one side they had the evidence of engineers who had been practically concerned in the laying of pipes, and on the other side they had only the evidence of an architect. He could only say further, as to the quality of the Paris gas, it was very much below that of London. In the former city the gas was called seven-candle gas, and in the latter the standard of illumination was eleven candles.

The Chairman said they must all feel indebted to Mr. Burnell for his interesting paper. It contained a large number of facts which could not fail to be of service to all who were interested in gas works. He confessed that on the topic which had received the largest amount of attention, he personally entertained some strong views. He was not at all afraid, though he had heard of explosions in the Paris subways, of such occurrences taking place in this country. Even if that room were closed up and the gas allowed to escape into it there would be danger of explosion; but if the upper windows were left open, with free ventilation from the bottom of the room, he should have no fear of this. Such a strong current of air might not be agreeable in a house, but it would not be objectionable in a subway. He had been present when gas was lighted in a subway and when, according to the views of some of his friends, an explosion should have taken place; but there was a sufficient current of air through it to almost blow out the flame of the gas. While that was the case there could be no fear of explosion from confined gas; and he was surprised to hear gentlemen say that proper attention had not been paid to that matter in the subways already constructed. It was true, as had been observed, that the subways were quite large enough for the entrance of thieves; but he had not yet heard of any depredations upon property through that means, and it would require the removal of a considerable amount of brickwork and other material to effect an entrance to the contiguous premises. He was sure all would agree that subways, if safe, must be of great public advantage. They could not fail to be a great benefit to the gas companies. He did not expect any great change to be effected without considerable opposition and discussion; but good resulted from this, for thus attention was drawn to any weak points, and those who had to conduct the improvements were led to avoid dangers that might otherwise arise. While so many advantages were held out he was persuaded that nothing would prevent this improvement from going on. Since this subject was first mooted he had seen great changes in public opinion, and in the minds of gas engineers themselves; and many who were opposed to subways—even amongst the engineers in Paris—were now looking forward to a better state of things, and even made propositions for introducing gas-pipes into the subways. He hoped a further discussion would take place on this subject, and that some of his friends would be led to modify their views. He was sure they would feel that a cordial vote of thanks was due to Mr. Burnell for his valuable paper.

A vote of thanks was then passed and acknowledged.

Obituary.

John Gibson, R.A., the eminent sculptor, died at Rome, on Saturday, the 27th January, in the 76th year of his age. He had been seized with a severe stroke of paralysis, from which there was no hope of recovery. He was born in 1791 at Conway, where his father laboured as a landscape gardener; but, fortunately for the child, circumstances compelled the elder Gibson to remove to Liverpool. Whilst living at Conway, young Gibson delighted in drawing on pieces of slate the geese, and sheep, and horses which he saw in the fields; and under his mother's fostering care, it is said, he acquired considerable facility of execution. At Liverpool, however, his fancy was fed with something higher, in the shape of art, than he had yet seen in the humble cottages of a Welsh town. Here he saw engravings, and studied and copied, all the while training his eye, heart, and hand. At the age of fourteen he was apprenticed to a cabinetmaker, an occupation repugnant to his tastes, and afterwards to a wood-engraver, for which employment he felt a stronger inclination. Fortunately, however, a Mr. Francis, a partner in some marble works, who had heard of his skill and his remarkable fondness for art, purchased his remaining time for £70, and generously encouraged his abilities in designing, modelling, and the use of the chisel. He also introduced him to Wilkie Roscoe, the celebrated author of the "Life of Lorenzo de Medici," a no mean patron of literature and the arts, who at once conceived the idea of sending young Gibson to Rome. Commercial losses, which came heavily upon the illustrious merchant at this time, prevented his carrying out the idea himself, but he kindly mentioned the project to some of his wealthy friends, and a sufficient sum was soon privately subscribed for the purpose. In 1817 John Gibson started on his journey, encouraged by an interview with Flaxman in London, and with letters of introduction to Canova at Rome, from whom he received cordial welcome. Canova assured him that with steady industry he would be certain to achieve success, and promised him every aid that he could render him, even going so far as to proffer pecuniary assistance should he need it; this he did not. After four years' study under Canova, Gibson set up on his own account, and produced a group of "Mars and Cupid," which was shown to the Duke of Devonshire. His grace was struck with its merit, and directed the artist to execute it in marble; it now forms one of the leading features of the magnificent collection at Chatsworth. Another of Gibson's earliest works was a group of "Psyche and the Zephyrs," which was purchased by Sir George Beaumont, but so highly was it admired, that young Gibson was requested to execute duplicates of it for Prince Torlonia and the Hereditary Grand Duke of Russia. On the death of Canova he became once more a pupil, and entered for a time the studio of the great Spanish sculptor Thorwaldsen. In 1823 Mr. Gibson was elected an associate of the Royal Academy, and in 1836 he became a Royal Academician. However, with the exception of short visits made to this country, he resided almost entirely at Rome, and so widely had his fame extended that his studio was the resort of the patrons, practitioners, and lovers of art. From the commencement of his career to the time of his death he devoted himself mainly to classic and poetic sculpture. In portrait statues his chief efforts have been; two of Her Majesty; a colossal figure of the late Hon. William Huskisson for the cemetery, Liverpool, a copy of which has been produced in bronze to adorn the front of the Custom-house of that City; Sir Robert Peel for Westminster Abbey; Mrs. Murray, exhibited at the Royal Academy in 1846; and George Stephenson, exhibited in 1851. He has also executed several monumental tablets and bassi-relievi. Several of Gibson's statues were tinted, the most remarkable being his celebrated Venus, which attracted so much attention at the International Exhibition of 1862. This was executed for the late Mr. Robert Berthon Preston, of Liverpool, and is now in the possession of Mrs. Preston, of Richmond-hill. England is tolerably rich in the *chefs-d'œuvre* of Gibson, some one or more of which have found a place in every good collection. Liverpool is particularly well supplied with specimens from his chisel; and the inhabitants of that city have not been backward in showing their appreciation of his merits, and in regarding him with pride as a fellow-townsman.

Publications Issued.

Modern Marine Engineering applied to Paddle and Screw Propulsion. By N. P. Burgh, engineer. (*E.* and *F. N. Spon.*) To be published in fifteen monthly parts, demy quarto, part 1 ready on the 1st January, 1866, and the remainder consecutively.—The work treats on ordinary, compound, and expansive engines adapted for paddle, single and twin screw propulsion; surface and injection condensers; expansion, equilibrium, slide, and other valves; link motion; starting gear; thrust blocks; paddle wheels; screw propellers; ordinary and superheating high and low boilers. The plates will be correctly tinted to pourtray the different materials with the recognised colours adopted by engineers for practical purposes. The complete work will comprise 300 pages of letter-press matter, illustrated by thirty highly-finished plates of engines, &c., contributed by the most eminent firms in England and Scotland. Numerous clear woodcuts will be interspersed, in order to assist the student as well as refresh the memory of the learned. All the examples depicted will be those of the latest and best known design and construction.

Notes.

Aeronautical Society of Great Britain.—This society has been formed under the Presidency of the Duke of Argyll, the Duke of Sutherland and Lord Richard Grosvenor, M.P., being Vice-Presidents, and Mr. James Glaisher, F.R.S., being the treasurer. Among the Council are Sir Charles Bright, M.P.; Dr. Hugh W. Diamond; Mr. William Fairbairn, LL.D., F.R.S.; Dr. John Lee, F.R.S.; Mr. H. E. Westcar, and others. Its objects are to foster and develope the science of aëronautics, which has stagnated for so many years, and incidentally therewith to increase our knowledge of aërology. In the hands of private individuals the progress made in aëronautics has been for any useful object almost *nil.* The great expense attending the necessary experiments combined with the absence of scientific and mechanical attainments on the part of aëronauts generally, considered in conjunction with the fact that their balloons were often in profitable requisition for purposes of amusement have doubtless contributed to the present uninteresting and unsatisfactory condition of the science of aëronautics. There are, however, many who have hoped much from the conjunction of educated science with balloon pioneering, and the Council of this Society are encouraged to believe that they will be supported in their efforts by the contributions of well-wishers. It is proposed to admit to membership upon payment of an annual subscription of £1 1s., and to appeal to the public for donations; to rent ground and construct balloons and apparatus for experiments; to furnish subscribers with tickets of admission to the grounds upon public days of experiments, and to issue a periodical of transactions and intended experiments, and to issue tickets for a seat in the car upon one of the days of ascent, the determination of which will take place by ballot amongst those subscribers who shall have sent in their names previously for that object. In a shed constructed for the purpose it will be possible always to maintain one of several balloons inflated ready for ascension, and if it were needful, and the Society possessed sufficient members, an ascent might be made every day at a certain hour (weather permitting). Persons desirous of membership should apply to the honorary secretary, F. W. Brearey, Esq., Maidenstone-hill, Blackheath.

Correspondence.

Labourers' Dwellings.—Sir.—Time did not permit of my saying a few words in regard to the very important subject mooted by Mr. Beggs' paper, read on the 31st ult. There is no doubt the main points to be attended to, in order to effect the great social improvements desired, were very clearly summed up by the chairman, as being the necessity for what was so ably insisted on by Mr. T. Webster, compulsory powers (properly regulated) for the acquisition of sites for improved dwellings for the labouring classes in the business parts of the metropolis and other large towns; government loans, on similar principles to the loans from government for drainage, &c., of land; and a system of selling freeholds or similar perpetual tenure rights in the separate tenements comprised in large blocks of buildings. As it seems to have been thought that the last mentioned point was one presenting some practical difficulties, and some difference of opinion seemed to exist as to whether the absolute ownership of dwellings would be beneficially exercised by some of the members of the industrial classes, the following suggestion in reference thereto may not be out of place. It is this:—the adoption of the system of selling tenements on long leases, say 500 years, renewable again and again for a small fine at peppercorn rent, with an annual payment of small amount, to be applied to the maintenance of the foundations, roof, external walls, and necessary structural supports of the block; the administration of this fabric-maintaining fund to be in the hands of trustees, who should be appointed in the first instance by the erectors of the buildings, but should be afterwards renewed by being nominated by the old trustees, and elected by the owners of the various tenements. A board of this kind might be entrusted to enforce covenants to be inserted in each owner's conveyance, this document being framed to prevent him from grossly misusing his property to the injury of his neighbours in the same block. Another suggestion, that may not be unworthy of consideration, is this. In many of our business streets west of Temple Bar, east of Aldgate, north of Smithfield, and south of the Thames, the shops and warehouses are all that is of much avail, the owners of them residing in the suburbs, and the upper parts of the premises are not letable for offices, the localities not being suitable. This being so, why could not the same measures be adopted as have been heretofore adopted with regard to some hotels in the city, that the ground and basement floors (and perhaps the first floor in some cases) could be effectually parted off from the upper floor, which last could be fitted up as tenements for the more prosperous classes of our working men, thus relieving the pressure upon the workmen's homes in the back streets. It has often occurred to me that something of this kind might have been done with some of those miserable carcases in Victoria-street, Westminster, where there are ample opportunities for making the entrances to the workmen's residences in a side street.—Yours, &c., F. W. Campin.

Temple, 2nd Feb., 1866.

Conservative Land Society.—Sir,—Permit me a few words in reference to the letter of Mr. Gruneisen, which appeared in the last number of the *Journal.* Those who have read my paper will see that my object was to show the success of freehold land societies in general, and to direct attention to them as an important means of meeting one of the greatest wants of the age. As the basis of my exposition, I did what I hope Mr. Gruneisen would have done had he occupied my place on the evening of the 31st inst., I took the society with the working of which I was most familiar. In doing that I had no wish to advertise a society with which I have an intimate connexion, and which needs no effort of that kind, much less did I desire to underrate the success of the excellent society of which Mr. Gruneisen is secretary. I rejoice in the success of every freehold land society. As to the "singular inaccuracy" upon which Mr. Gruneisen remarks, the figures were given to me by himself. I called upon him in August or September last, stating that I was preparing a paper for the Social Science Congress, to be held in the month of October at Sheffield. In that paper the figures were used just as I received them from Mr. Gruneisen, and were quoted freely both by the local papers and some of the London papers, and their correctness was not questioned. As I had a general principle to illustrate in my paper read before the

Society of Arts, I took them as sufficient for my purpose. It appears, however, that in the interval another report had been issued by the Conservative Land Society, which included the results of the operations of twelve months not included in the statement given to me by Mr. Gruneisen. In the case of the National Freehold Land Society, I took the figures just as I used them at Sheffield, and did not give it credit for the results of the most successful year the society has ever known. This will be a sufficient answer to any suspicion of unfairness. Many successful societies might complain of no mention being made of them at all, but I did not aspire to give a series of statistical returns, but, as I have said, a number of facts to elucidate a principle.—I am, &c., THOMAS BEGGS.

37, Southampton-street, Strand, W.C.

MEETINGS FOR THE ENSUING WEEK.

MON......Medical, 8. Clinical discussion. Mr. De Meric, "On the use of mercury in syphilis." Mr. R. Wm. Dunn, "On the mercurial and non-mercurial treatment of syphilis."
Asiatic, 3.
Society of Engineers, 7. Discussion on Mr. Thomas Adams' paper, "On the friction of the slide valve."
Society of Arts, 8. Cantor Lecture. Mr. Fleeming Jenkin, F.R.S., "On Submarine Telegraphy." (Lecture IV.)
R. United Service Inst., 3. Mr. H. D. Cuningham, "On his methods of working and training heavy guns."

TUES....Civil Engineers, 8.
Statistical, 8. Col. Sykes, M.P., F.R.S., "On the organization, strength, and cost of the French and English navies in 1865."
Pathological, 8.
Anthropological, 8.
Royal Inst., 3. Professor Tyndall, F.R.S., "On Heat."

WED....Society of Arts, 8. Mr. Thomas Gray, "On modern legislation in regard to the construction and equipment of steam ships."
Meteorological, 7. 1. Mr. C. O. F. Cator, "On daily weather diagrams, 1865." 2. Mr. G. J. Symons, "On the fluctuations of the annual fall of rain."
Geological, 8. 1. Mr. R. Lechmere Guppy, "On the Tertiary Mollusca of Jamaica." Communicated by Mr. H. Woodward. 2. Mr. R. Lechmere Guppy, "On the Tertiary Echinodermata of the West Indies." Communicated by the Assistant-Secretary. 3. Mr. R. Lechmere Guppy, "On the Tertiary Brachiopoda of the West Indies." Communicated by the Assistant-Secretary. 4. Mr. J. Young, "On the affinities of *Platysomus* and allied genera." Communicated by Prof. T. H. Huxley, F.R.S. 5. Dr. John Young, "On the scales of *Rhizodus*, Owen.
London Institution, 7.
R. Society of Literature, 8½.
Archæological Society, 8½.

THURS....Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.
Royal Inst., 3. Professor Tyndall, F.R.S. "On Heat."

FRI......Royal Inst., 8. Mr. William Pengelly, "On Kent's Cavern, Torquay.

SAT......Royal Inst., 3. Professor Westmacott, R.A., "On Art Education and how works of Art should be viewed."
Royal Botanic, 3¾.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. Numb.

Delivered on 2nd August, 1865.

380. Metropolitan Toll Bridges Bill, and Chelsea Bridge Toll Abolition Bill—Special Report.
401. Waterworks Bill—Special Report.
412. Africa (Western Coast)—Report and Evidence.
429. Caledonian Canal—Sixtieth Report of Commissioners.
438. Gas Companies (Metropolis)—Accounts.
435. Russian Epidemic.
442 (A). Poor Rates and Pauperism—Return.
445. East India (Badshapore Case)—Return.
448. Electors—Return.
450. Bishop of Capetown—Return.
452. Constabulary (Ireland)—Return.
470. Sugar—Return.
472. Public Accounts—Return.
483. Electors, &c. (London)—Return.
491. Pier and Loan Funds (Ireland)—Accounts.

SESSION 1864.

507 (B). Poor Rates and Pauperism—Return (B).
507 (C). Poor Rates and Pauperism—Return (C).

Delivered on 3rd August, 1865.

Railways in India.
Customs—Ninth Report of Commissioners.
Civil Service Commissioners—Tenth Report.

Delivered on 7th August, 1865.

403. Education—Report and Evidence.
437. Naval Prize Money, &c.—Account.
442 (A I). Poor Rates and Pauperism (April 1864 and 1865)—Return.
449. Highways Act—Return.
485. Twenty-ninth Canon—Correspondence.
487. Cape Town and Dock Railway—Correspondence.

SESSION 1864.

528. Prince Edward's Island—Return.

Delivered on 12th August, 1865.

Poor Law Board—Seventeenth Annual Report.

Delivered on 14th August, 1865.

349. Finance Accounts—Parts I. to VII.
375. Revenue (Ireland)—Return.
383. Baths and Washhouses Acts—Return.
399. Thames River—Report from Committee.
490. Banks of Issue—Return.

SESSION 1864.

507 (B I). Poor Rates and Pauperism—Return.

Delivered on 17th August, 1865.

330. Taxation of Ireland—Report and Evidence.
420. Standing Orders of the House of Commons.
Colonial Possessions—Reports (Part II).

Delivered on 21st August, 1865.

266 (III). Oaths and Declarations—Further Return.
293. East India (Troops and Police)—Return.
361. Industrial and Provident Societies—Return.
413. Public Accounts—Report from Committee.
422. Steam Vessels—Return.
463. Army (Manufacturing Establishments)—Return.

Delivered on 24th August, 1865.

Public General Acts—Table of.

Delivered on 25th August, 1865.

342. East India (Remunerative Works)—Abstract Statement.
343. East India (Canals).
390 (I). Open Spaces (Metropolis)—Index to Reports.
421. Printed Papers—Return.
425. East India (Army)—Return.
462. Enfield Rifles—Return.
465. Navy (Dockyard Accounts)—Report.
465 (I). Navy (Dockyard Accounts)—Report.

Delivered on 2nd September, 1865.

52 (VII). Trade and Navigation Accounts (31st July, 1865).
442 (A II). Poor Rates and Pauperism—Return (A), June, 1864-65.

Delivered on 5th September, 1865.

402. Tenure and Improvement of Land (Ireland)—Report, Evidence, &c.
476. Income Tax (Abatement)—Return.

Delivered on 11th September, 1865.

357. Postal Service (Ireland)—Returns.
410. Friendly Societies—Report of Registrar.
459. Rifled Guns—Return.

Delivered on 20th September, 1865.

419. Health of the Navy—Statistical Report.
442 (A III). Poor Rates and Pauperism—Return (A), July, 1864-65.
464. River Shannon—Lords Report.

Delivered on 27th September, 1865.

Inland Revenue—Ninth Report of Commissioners.
Children's Employment Commission (1862)—Fourth Report of Commissioners.

Delivered on 30th September, 1865.

52 (VIII). Trade and Navigation Accounts (31st August, 1865).
469. Income and Property Tax—Return.

Delivered on 7th October, 1865.

414. Dogs (Metropolis)—Return.
460. Canada (Transport of Troops)—Return.
488. Natal Railways—Correspondence.

Delivered on 14th October, 1865.

481. Public Schools Bill—Lords Report.

Delivered on 20th October, 1865.

442 (A IV). Poor Rates and Pauperism.

SESSION 1864.

507 (C I). Poor Rates and Pauperism—Return (A), August, 1864-65.

Delivered on 2nd November, 1865.

52 (IX). Trade and Navigation Accounts (30th September, 1865).
316. Import and Export Duties—Return.

Delivered on 10th November, 1865.

412 (I). Africa (Western Coast)—Index to Report, &c.

SESSION 1864.

507 (E). Poor Rates and Pauperism.

Delivered on 20th November, 1865.

456. Railways—Return.
474. Spirits (Scotland)—Return.

Delivered on 25th November, 1865.

439. Savings Banks—Return.
442 (A V). Poor Rates and Pauperism—Return (A), September, 1864–65.
455. Union Valuation Lists—Return.
471. Newspapers—Return.
492. Bristol Episcopal Residence—Papers.

Delivered on 2nd December, 1865.

52 (X). Trade and Navigation Accounts (31st October, 1865).

Delivered on 7th December, 1865.

403 (I). Education—Index to Report and Evidence.
441. Woods, Forests, and Land Revenues—Forty-third Report of the Commissioners.

Delivered on 12th December, 1865.

360. Lighthouses, &c.—Reports to Board of Trade.
442 (B). Poor Rates and Pauperism—Return (B), Paupers relieved on 1st July, 1865.

Delivered on 27th December, 1865.

442 (A VI). Poor Rates and Pauperism—Return (A).
467. Endowed Grammar Schools—Return.

Delivered on 1st January, 1866.

52 (XI). Trade and Navigation Accounts (30th November, 1865).

Delivered on 6th January, 1866.

404. Scurvy in Merchant Ships.

Delivered on 11th January, 1866.

243. Pilotage—Return.

Delivered on 29th January, 1866.

442 (A VII). Poor Rates and Pauperism—Return (A).
479. Local Government Act (1858)—Seventh Annual Report.
489. Post Office Savings Bank—Return.

Delivered on 30th January, 1866.

Trade and Navigation of the United Kingdom (1864)—Annual Statement.

Delivered on 7th February, 1866.

Jamaica—Papers relative to the Disturbances (Part I).
Jamaica—Further Papers (Part II).
Jamaica—Papers relative to the Affairs of.
North America, No. 1 (1866)—Correspondence respecting the "Shenandoah."
Brazil—Papers respecting the renewal of Diplomatic Relations.
Manufactures, Commerce, &c.—Reports by Her Majesty's Secretaries of Embassy and Legation.
Coal—Reports from Her Majesty's Secretaries of Embassy and Legation.

Delivered on 9th February, 1866.

Post Office—Eleventh Report of the Postmaster General.
Capital Punishment—Report of the Commissioners, Evidence, &c.
Sea Fisheries—Report of the Commissioners, Vol. I.
Douro Wine Trade—Correspondence.
Austria—Treaty of Commerce.

SESSION 1865.

433. Metropolitan Workhouses—Return.

Patents.

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From Commissioners of Patents' Journal, February 9th.

GRANTS OF PROVISIONAL PROTECTION.

Boats—232—W. K. Hall.
Boats, detachable eye for launching—285—W. Clark.
Boats, lowering—259—E. Ambrose and W. Braddon.
Boilers, &c., heating water for suppling—218—T. Prideaux.
Bricks, pressing—112—H. A. Dufrene.
Bricks, waterproof—40—E. Taylor.
Engines—44—W. Winter.
Fatty matters, distilling the grease of—297—C. Doughty.
Fire-arms, breech-loading—283—J. Snider, jun.
Fire-arms, revolving—299—W. R. Lake.
Fire-proof floors—224—R. Moreland, jun.
Force pump and garden engines—198—C. W. Orford.
Fruit beverages—34—F. Wright.
Furnaces—98—D. Hall.
Furnaces, heating—208—P. W. Bennitt and J. Matthews.
Gas stoves, combustion of gas in—110—J. C. Thompson.
Guns, revolving breech-loading—152—W. Ager.
Hydraulic machinery—279—A. Arthur and B. Davis.
Iron and steel, furnaces used in making—202—W. Jeffries.
Iron and wood, drilling, &c.—2820—J. Curtis.
Knives, handles for—142—J. and W. Bottom.
Ladies' dresses—206—W. C. Jay.
Lamps, composition for burning in—309—A. Dembinsky.
Leather, substitute for—4—M. Lohren.
Lubricating purposes, apparatus for—263—J. H. Johnson.
Mechanical motion, producing—220—W. Brookes.
Metals, moulds for casting—196—W. Thomas, jun.
Metal tubes, &c., casting—172—W. Sumner.
Mirrors, centres for swinging—248—J. Soutter, sen.
Moulds, drying—231—M. H. Lishman and E. Chambers.
Motive power, electro-magnetic engines for obtaining—311—W. Darlow.
Paper—2726—J. Wright.
Potatoes, cooking—106—P. L. Charon.
Quartz, &c., crushing—275—A. B. Childs.
Railway and other carriages, axle-boxes of—253—F. Wise.
Railway and other lamps—307—C. E. Giajola.
Railways—287—J. Berrie.
Reaping and mowing machines—204—J. H. Johnson.
Screw apparatus, differential—273—R. A. Brooman.
Sewing machines—295—A. Smith.
Sewing machines, feed motion for—247—W. Winter.
Ships, closing the hatchways, &c., of—219—C. E. H. C. Healey.
Soils, preparing—240—T. Spencer.
Spindles, grinding or glazing—293—S. B. Ardrey, S. Beckett, and W. Smith.
Spinning, preparing fibrous substances for—230—W. Dore, J. Tapley, and J. Cordwell.
Stage illusions, producing—184—G. Tanner and G. Parkes.
Steam boilers—148—R. Cherry, E. Crossley, and W. Bower.
Steam boilers—194—W. K. Hall.
Steam boilers—226—J. Howard and E. T. Bousfield.
Steam boilers, preventing incrustation in—228—M. Silvester.
Steam boilers, vertical—166—D. Adamson.
Steam engines—281—J. Orr.
Steam engines, generator for—214—W. E. Gedge.
Steam engines, lubricating—167—H. Ashworth.
Straps or driving belts, splicing—249—G. Dyson.
Straw, &c., washing—143—J. Samwells and S. Nye.
Weaving, looms for—234—D. Lord, T. Lancaster, and R. Bennett.
Weaving, looms for—303—R. Clayton, J. Raper, J. Goulding, and W. Howarth.
Woven fabrics, folding, &c., of—77—J., C., and H. Sampson, and A. Lockwood.
Yarn, spinning—178—A. V. Newton.
Yarns or warps to be woven, preparing—271—S. Cook and W. H. Hacking.

INVENTION WITH COMPLETE SPECIFICATION FILED.

Woven fabrics, cutting, &c.—351—A. Mahieux.

PATENTS SEALED.

2080. W. T. Cole, H. S. Swift, and A. Soares.
2095. H. Woodward.
2096. R. A. W. Westley.
2099. W. F. Henson.
2100. J. T. Lockey.
2102. J. Gamgee.
2103. R. C. Lilly & J. Sunderland.
2121. S. Phillips and J. Groves.
2134. J. L. Clark.
2150. J. B. Austin.
2448. W. Unwin.
2636. W. Mather.
2748. A. V. Newton.
2772. W. E. Newton.
2899. H. C. Carden.
2980. J. B. Edge and E. Hird.
3136. T. L. Nicklin.
3205. M. Klotz.
3300. H. A. Bonneville.

From Commissioners of Patents' Journal, February 13th.

PATENTS SEALED.

2111. J. Billings.
2114. J. Ingham and J. Culpan.
2125. E. Rimmel.
2127. A. V. Newton.
2137. R. A. Brooman.
2138. G. Howard.
2147. R. A. Brooman.
2151. W. Soper.
2215. G. Robinson.
2255. A. V. Newton.
2366. W. Clark.
2428. C. and T. White.
2439. A. V. Newton.
2947. M. Caton and H. Holden.
3022. W. E. Newton.
3024. A. V. Newton.
3197. W. J. Murphy.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

342. J. Cameron.
23. H. Jones.
358. J. Goucher.
367. W. Whitaker & W. Tongue.
368. A. Corneau.
375. W. Symington.
396. S. Whitaker.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

383. J. Evans.
356. J. B. Redman.
357. A. Clark.
422. J. T. Jones.
401. G., G. W., and J. Betjemann.

Registered Designs.

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A Potter's Kiln Brick—February 1—4769—Messrs. Proctor and Lunt, Williamson-street, Tunstall.
Gas or Air Tight Flap—February 1—4770—J. N. Smith, 2, Camden-place, South-street, Greenwich.
Silent Reclining Perambulator—February 2—4771—A. R. Hardisty, Liverpool.
Call Bell—February 2—4772—W. Tonks and Son, Birmingham.